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TWENTY-NINTH ANNUAL REPORT

FOR THE CALENDAR YEAR 1939

- Northern -
Rocky Mountain
Forest & Range
Experiment Station
Missoula, Montana

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THE RESEARCH ACTIVITIES OF THE STATION

GENERAL

Coordination of effort in solving major forestry problems has been a dominant theme in 1939 at this station. In common with others, this station has been increasingly concerned with cooperative projects, some intra-station, some between the station and the administrative organization, and some linking the station to other public agencies. These cooperative undertakings are a natural outgrowth of a wide community of interest in forest land management, recognition of the necessity for joint attack on its problems, and a desire to put research findings into application. These projects have occupied much time and attention, have raised problems in working relationships, and have a definite bearing on the organization of research within the station.

A highly cooperative undertaking in forest land management developing in 1939 was farm forestry. Involving most public agencies in the region having an interest in either the farmer or forestry, constructive accomplishment necessitates cooperation and coordination to the nth degree. The station had a large body of applicable information to contribute and has spent considerable time assisting in the preparation of the Montana and Idaho state farm forestry plans, and in preliminary formulation of recommended research projects to enlarge the factual basis for the program. No one division in the station had a monopoly on contributions. Grazing and silviculture, representing land uses often directly competitive on farm woodlands,

both had large stakes in the program. Valuable information on uses and markets was furnished by products and the over-all statistical setting was supplied by the forest survey.

Another cooperative undertaking developing in 1939 that involved many interests and lines of endeavor, both in and out of the station, was slash disposal in the western white pine forests. It is today one of the most debated forestry issues in the white pine region albeit one of the oldest. It has been recently attacked by the Inland Empire subsection of the local section of the Society of American Foresters. The complexity and variety of interests involved is indicated by the appointment of four subcommittees on (1) public and community interest, (2) silviculture, (3) protection, and (4) economics and finance. The station, represented on the protection and silviculture subcommittees, has a worthwhile contribution to make. So do other agencies. And over these individual contributions is the more difficult job of integration.

Within the past year considerable interest has developed in the possibilities of converting certain types of burned over forest lands more or less permanently to range use to provide needed forage resources for nearby farmers. In addition to the technical problems of seeding, difficult ecological, economic, and social questions of land use are involved that will require the concerted efforts of research and administrative organizations both in and out of the Forest Service to integrate.

This tendency to combine forces on common problems is also developing within the station especially in the forest group of silviculture, fire, products, and the forest survey. Each division has been in existence long enough to have assembled a considerable store of factual information. All have much community of interest and each is increasingly seeking outlet for its wares. There has been much dipping into one another's stocks. Products has supplied literally bundles of data on consumption of forest products, lumber prices, stumpage prices, and the like to the forest survey, and has worked with silviculture in developing a utilization road plan and initiating methods of cutting and utilization tests on the Deception Creek Experimental Forest. Silviculture has drawn heavily on fire and products in making a white pine management study. The forest survey has contributed liberally to everybody.

Joint attack on common problems in forest land management and free interchange of information both within and without the Service is necessary for continued progress and in line with Secretary Wallace's desire to improve and better integrate the conservation program of the Department. Realization of this program, however, creates some problems in forest research organization that must be met to insure continued and harmonious progress.

There is a practical limit to the effectiveness of cooperative studies. Instances within the station or involving outside agencies, wherein all participants work effectively together and contribute more or less equally, are scarce. Cooperative undertakings tend to be inefficient insofar as concrete results are concerned;

they usually sound better than they are. In an attempt to please everyone, too many answers are often sought at once; appendages are often tacked on "to get some data on this point" that do not yield results commensurate with the effort expended. Procedure and overhead pile up. At stations with a small staff these studies are an especial problem since a choice must often be made between essential project work and cooperative studies. Most project leaders properly feel that their major responsibility is to get results on problems in their respective fields and "view with alarm" the inroads made on their time by cooperative studies. Yet cooperative studies are here to stay and can be made to work. It is believed, however, that wherever practicable projects involving several groups within the station or outside agencies should be directly assigned to the one most closely concerned, with the others functioning on a contributory rather than an equally cooperative basis. The distinction between cooperation and contribution has often not been made and frankly recognized in organizing a project.

Joint attack on common problems in land management places an especial premium on close working relations with the administrative branch, which in this region is the main outlet for research findings. Outstanding accomplishments of a few years ago in fire control planning were in part due to the fact that research and administration were practically fused in attacking the problem. The entire fire research project was called for and has received the closest sort of cooperation between the station and the regional office. Most problems in forest and range land management require

a similar coordinated approach. There is a need for development of better and more mutually understanding working relations with administration.

Limitations of a purely cooperative approach and the closer rapport necessary between research and administrative effort leads to recognition of the existence of a class of over-all and integrating studies that cut across present division lines and consideration of ways and means of most effectively handling them. Study of the economics of growing western white pine forests, earnestly recommended by this station for several years but at present lacking finances, is a case in point. The basic need for such a study, bringing together and putting the breath of life into the mass of factual material assembled by the several station divisions, is increasingly apparent. Such a study is far from being new but never before has such a wealth of supporting information been available.

Studies of this nature do not neatly pigeonhole into any existing research division in the station. Each division contributes to forest management but none is squarely in the field itself. Exactly how such projects should be organized and supervised depends quite largely on current organization, finances, and available personnel. The essentials are to recognize the existence and importance of these studies, maintenance of flexibility in organization, willingness to temper divisional interests to station needs, close working relationships with the administrative organization, and sufficient unity in project leadership to avoid the difficulties of too many cooks.

Accomplishments and problems directly relating to each division follow:

SILVICULTURE

Fitting silvicultural findings into management practice was given especial attention in 1939. During the year a study of the economic-silvicultural aspects of growing western white pine forests was made in an earnest attempt to orient silvicultural research in timber management.

Possibilities of various kinds of cutting methods applicable in western white pine stands were analyzed in detail. In mature stands containing large volumes of species other than western white pine, which at the present time are largely unmerchantable, economic limitations force a compromise between what can and what should be done to get best future growth. By drawing heavily on logging and milling information obtained by the forest products division, it was estimated that in most such stands private operators could profitably employ a two-cut installment system of harvesting the stand that would result in satisfactory regeneration to western white pine and its associates on at least a third of the total area cut over and the preservation of sound but currently unmerchantable trees with some natural reproduction on the other two-thirds. The silvicultural results of such a system would be superior to those obtained with a destructive single cutting removing all merchantable trees.

In young white pine stands just reaching merchantable size, considerable partial cutting possibilities seem to exist. Higher yields per acre per rotation than those obtainable from a single cutting plan can be had through profitable harvest of some of the

natural mortality and maintenance of a faster average growth rate. A partial cutting system was developed in accordance with a definite silvicultural plan of management that called for four partial cuts at approximately 20-year intervals, the last being the removal of an open shelterwood with even-aged reproduction beneath. Though growth and mortality estimates made in this analysis were believed conservative, rotation yields per acre were increased about 40 percent over those obtained from a comparable single-cutting plan.

This comparative analysis of cutting methods was integrated into long-time timber growing plans with all costs included as nearly as they could be estimated. Assuming present-day conditions and a "going concern," or fully regulated forest, returns slightly exceeded direct costs for the four-cut plan. White pine blister rust control, however figured, was a major timber growing cost though with the permanent establishment of ribes-free conditions future costs will greatly decrease.

Analysis of stand improvement measures applicable in young western white pine stands lead to the conclusion that under existing and probable future conditions the best financial showing is made by cleanings applied once or twice before the stand reaches approximately 20 years of age. A maximum improvement in species composition is possible then plus some control of density. After cleaning, stands should be let alone until commercial harvest cuttings can be initiated.

This study, while necessarily involving much long range estimating difficult of categorical proof, has none the less given increased perspective in orienting silvicultural research in relation to other phases of forest management. An over-all conclusion of the entire study was that direct integrating studies in the field of forest management proper were a major present need.

Initiation in 1939 of a joint project with the Spokane Blister Rust Control Office of the Bureau of Entomology and Plant Quarantine to bring together timber management and blister rust control information in a report under the approximate title "Blister Rust Control in the Management of Western White Pine" was a forward step in cooperative relations. Blister rust control is closely related to management practice mainly through the effect of the latter on the eradication of ribes, alternate host of the causal organism. Cutting practices in mature stands, improvement measures in immature stands, slash disposal, in fact almost every forest operation, has an effect on the establishment and growth of ribes. In addition to these relationships, such practical questions as: How much infection can white pine stands of different ages and stocking endure without permanent damage? must be answered. Much factual information on ribes ecology and on the incidence and spread of the disease has been assembled. Integration of this material with forest management knowledge is a necessary step in developing most economical and effective disease control methods.

During the past year, material additions to our knowledge of stand development in the western white pine type during the early and formative period, roughly the first 20 years, have been made.

A thorough understanding of developmental trends during this period is necessary to proper management as it is then that future stand values are largely determined and improvements in stand composition and density can be most effectively and economically made. During the past year, 12 permanent plots in reproduction stands were remeasured to study compositional changes during a 5-year period. The effect of a weeding operation on stand development was studied in detail on three other plots. Six cutting areas on which we had previously followed the establishment of natural reproduction from the time of cutting were revisited to get information on the influence of residual overwood density on the composition and development of the reproduction. Data obtained on these areas clearly brought out the inhibiting effect of an overdense residual overwood on reproduction, especially of white pine.

We now have a good working knowledge of reproduction development in the northern and central portions of the western white pine type. With data from the southern portion of the type, to be obtained during the summer of 1940, sufficient information will be available for preparation of a published report on the subject.

Artificial regeneration studies have been confined to direct seeding with notable progress during the past year. The possibility of successful direct seeding on at least the more favorable sites was demonstrated on plots sown in the fall of 1937 and the spring of 1938 with seed of western white pine, ponderosa pine, and Engelmann spruce. Second-year examinations on these plots showed that fall sowing in spots protected with screens, which were removed after

the first year, was the best treatment of those used, resulting in an average survival of one or more seedlings in 90 percent of the spots sown, only 4 percent less than survival at the end of the first growing season. Since screening was deemed too expensive for extensive application and not considered essential on most white pine sites for the physical protection of the seedlings, testing of poisons as a less expensive method of rodent control was a logical second step in the search for practical direct-seeding methods. Two large scale tests of poisons in sowings of western white pine made in the spring of 1938 were definitely successful with 85 percent survival on one area and 69 percent on the other. These areas were sown at a cost of $7.83 per acre, which is about 70 percent of the cost of planting including administrative overhead. First-year results on tests of western red cedar indicate that this small seeded species might be successfully direct seeded on favorable sites where root competition is not a factor without protection from rodents.

Plans for 1940. 1. Push analysis of silvicultural research in western white pine. Involved is a careful stock-taking of past accomplishment, analysis of future needs and priorities, and a general orientation and integration of silvicultural knowledge with forest management practice.

2. Continue semi-large scale work in direct seeding to give thorough test of methods developed. In keeping with the greatly expanded planting program in Region One, it is also especially important that aggressive new research in nursery practice and

forest planting be undertaken by the station. Work in this field is now confined for lack of funds to assistance to the region on cooperative planting studies.

3. Round out study of early reproduction development in western white pine by additional field work in the summer of 1940, preparation of two short releases and a rather comprehensive report on the subject.

4. Continue cooperation with the blister rust control organization. Prepare cooperative report "Blister Rust Control in the Management of Western White Pine," which will bring together blister rust and timber management information.

5. Continue extension work with Region One on timber stand improvement. Revise and reissue stand improvement manual. Prepare progress reports on several thinning plot installations now yielding usable results.

6. Complete preparation of "show-me" material for silvicultural work at Priest River and Deception Creek field stations. An acute need for such material, as an effective means of making silvicultural work better known and understood, exists that has only partially been met in the past.

7. Prepare more detailed plans for methods of cutting and stand improvement installations on the Deception Creek Experimental Forest. Push development of utilization road systems by construction of about 9⅛ miles of road in 1940 in connection with light salvage cuttings on the forest.

8. Lay plans for initiation of research in forest soils concentrating attention on the effects of burning on the soil.

9. Continue cooperation with the University of Idaho on pathological studies in the western white pine type. Plans for 1940 include furnishing of facilities at the Priest River Station for a graduate student to conduct an extensive survey of abundance and incidence of fungi in the western white pine type.

FIRE RESEARCH

With the exception of a new attack on the complex problem of fire behavior in different fuel types, fire research work was at ebb tide during 1939. Previous investigations of the chemical constitution of various plants and its effect upon plant inflammability throughout each growing season had to be dropped due to insufficient funds; morning measurements in the study of effect of timber canopy density had to be dropped; Hayes left in September on 8 months' leave to acquire his Master's degree; and duff hygrometers, one of the previous standard methods of measuring fuel moisture, proved so difficult to hold in calibration that their use will be discontinued in 1940.

Dropping the chemical studies of growing vegetation, which either retards or accelerates fire, was not serious because the previous investigations had been incomplete by lacking, since the second year of this work, the concurrent tests of inflammability that are, of course, essential to determine the practical effects of changes in the chemical condition of plants. Seasonal trends of fat and oil content, and of calorific values, never before known for our species of grasses, forbs, and shrubs, have now been

determined, but the effects of these trends cannot be stated dependably until inflammability tests are possible.

Periodic determinations of plant and soil moisture were continued and the 5-year data now show the seasonal trends of these important conditions. The forbs - fern, thimbleberry, dogbane, fireweed, and yarrow - were found to behave as a group, having the highest moisture contents throughout the season from mid-April to late September, and ending the season with each pound of vegetable matter still holding about 1½ pounds of water. The shrubs - willow, ninebark, ocean spray, and ceanothus - had moisture contents lower than the forbs by amounts of 300 percent or more in the spring and had about a pound of water for every pound of vegetable substance, or 100 percent moisture content, at the end of the season. Of the two grasses studied, pinegrass surprisingly followed the shrubs while downy chess or cheat grass was intermediate between the forbs and the shrubs on May 1 but dropped to the cured and highly inflammable condition of only 10 percent moisture content by July 20. Pinegrass and yarrow apparently respond to fall rains and often show higher moisture contents; hence lower inflammability on October 1 than on August 31. Soil moistures in northern Idaho are generally down to the low level of 7 percent to 9 percent from August 10 to 31, at all three depths measured, 0-6 inches, 6-12 inches, and 12-18 inches, the deeper layer being consistently the driest. All of this work is to be discontinued in 1940.

The elimination of morning measurements in the study of effect of timber canopy density on meteorological and fire danger

factors was not ruinous, although it would have been serious had 1939 been a wet year. Sufficient data are now available from this study to test, except for wet years, the conclusions found by Jemison in 1934 and 1935, and published under the titles, "The Significance of the Effect of Stand Density Upon the Weather Beneath the Canopy," and "Influence of Weather Factors on Moisture Content of Light Fuels in Forests of the Northern Rocky Mountains." Such data have a direct application in the development of fire behavior meters by fuel types and a fire dispatcher's meter both now recognized as needed in this region.

Data for a fifth season were obtained from the study of weather and fire danger factors as they vary with altitude, from valley bottom to mountain top, and with aspect, from north-facing to a south-facing slope at each elevation studied. For the last several years this study has been given top priority in our fire research work at the Priest River Experimental Forest because it deals with the fundamental question of <u>where</u> fire danger should be measured, and because its exceptional instrumental equipment - continuous recording for nearly all factors - provides direct information to answer the basic question: <u>At what time</u> or times of day should fire danger be measured? Such knowledge is essential to the construction of dependable fire behavior and fire dispatcher's meters.

Data from four seasons of measurement by altitude and aspect have been analyzed and a report prepared and edited for publication. Although seemingly most suitable for use in the Monthly

Weather Review that medium appears to be blocked by a shortage of funds resulting in an over-supply of material; hence a serious delay in publication, especially of long articles comprising many charts for proper presentation. As the results of our altitude and aspect study have direct and immediate possibilities of application in both fire danger measurement and fire control planning, this situation is regrettable but will be solved somehow.

The next essential step in this study of altitude and aspect is, of course, to determine whether or not the findings for one particular ridge, running from west to east, from 2,300 feet to 5,500 feet, in northern Idaho, hold true on similar and on different ridges in the canyon-type topography of central Idaho, the more rugged mountain type of the extreme northern Rocky Mountains, and on the steeper slopes at the higher base elevations of, say, Yellowstone Park, where the valley bottoms are about as high as the mountain top so far studied. Such tests are entirely feasible and are planned for the 1940 season. This will result, of course, in discontinuing this work at Priest River in order to move the instruments and highly trained personnel from place to place.

Financed entirely by the regional office division of fire control but directed by the experiment station, a new and long needed study of fire behavior in different fuel types was commenced in 1939. Such work is essential to the testing of the fuel type classification scheme evolved by Hornby of this station in 1933, and applied in 1933 and 1934 as a basic step in fire control planning on 17,000,000 acres of national forest in this region. Although Hornby's preliminary

tests in 1936 and 1937 indicated reasonable consistency, individual cases of actual fire behavior exhibited deviations that revealed worthwhile possibilities of refining his initial rules of classification.

During 1939 some 40 fires were set or found while small and their rates of spread carefully measured in their particular fuel types which were carefully classified. All fire danger factors, such as fuel moisture, humidity, and wind, were likewise measured so that the rates of spread could be sorted not only according to fuel type but also according to class of day. Similar data also were obtained for some 2,000 fires of the past 3 years for which the standard reports showed the size of fire on discovery, size on arrival, hence elapsed time, and therefore rate of spread by fuel type and by class of day as measured at the nearest inflammability station.

Analysis of these data has only begun and permits only the statement that the results show a consistency verifying the basic soundness of Hornby's original classification. The data also show a variability or frequency of departure from the average for any fuel type and class of day such that further research can clearly be expected to improve both the fuel type classification and the danger measurement. It is also apparent, as should have been expected, that even with much greater refinement of both fuel classification and danger measurement, a dependability of 100 percent should never be expected.

There will always be a few fires which, due to exceptional peculiarities of the fuel type at that spot, due to a very temporary and localized wind, due to the position or size of the fire with respect to the topographic slope above or below it, and due to combinations of minor factors not incorporable in even a refined fuel type classification or danger measurement scheme, will produce rates of spread considerably different from the average for a specific fuel type and danger class. It is believed, however, that the present frequency of exceptional behavior can be reduced to reasonable limits by the application of additional well controlled research. Apparently such work will be possible at this station in 1940 only if financed again by the regional office. Research funds are entirely lacking.

The outstanding major condition now confronting fire research in this region is both an obstacle and a challenge. It was summarized in last year's report as the "vital question of justifiable cost of forest protection" which "is intimately associated with land-use planning" and which is, of course, basic to organization planning on the national forests. During the past year the intimate relation of fire danger measurement to fire control organization action has been developed and clarified considerably. This is no longer an academic relation adequately handled by publication of a few technical articles. It is a hard pressing practical problem of dollars and cents or, rather, thousands and tens of thousands of dollars.

The actual application of danger measurements to control of the size of the fire organization during the past several years has focused the attention of administrative men on these measurements more frequently and more emphatically with each succeeding year. Administrators now generally accept the principle of danger measurement, which was originated and gradually developed for them by research, but they now, for the first time, are beginning to specify how this principle should be applied. Such specifications naturally reflect on certain features of the methods of measurement and the entire subject is therefore now susceptible to a new and consequently valuable approach.

The Washington office examination of the possibility of a national scale of fire danger has resulted in some 40 pages of comments and opinions that can be condensed into specifications of what a danger measuring scale should and should not attempt to do from the administrative standpoint. This constitutes the first administrative ground upon which fire research men have been able to stand in viewing their objectives. In each region, however, the objectives and methods must be specialized to suit regional timber values, fuel types, causative agencies, and weather. It is therefore proposed that in 1940 the chief of the experiment station division of forest protection will devote at least 2 months of his field time to field trips with the regional foresters and regional fire chief examining, on the ground, those conditions which should influence future fire research in this region. The result will be a complete recasting of our fire

research program incorporating the administrative desires crystallized during the past few years, tempered by the research knowledge to date of what can now be done and what must be investigated further if it is to be done dependably.

FOREST PRODUCTS RESEARCH

From time immemorial, forests and humans have been closely associated. A calm and retrospective view will show that importance attaches to forests because they are the source of jobs for men, wages and payrolls, industrial prosperity, community stability. In the Northern Rocky Mountain region particularly, these benefits are of major importance. The lumber industry is the most important manufacturing industry of the region and in normal times 60,000 people (wage earners and families) are dependent upon the utilization of wood for a livelihood.

So far as the research in the division of forest products is concerned, the central theme continues to be the efficient utilization of wood. Though this research is chiefly aimed at logs and lumber, it correlates in turn with jobs for men, industrial prosperity, and community stability.

Timber Conversion Investigations

The bulk of the time of the product's staff is devoted to timber conversion investigations; studies in the sawmill, studies in the woods; all aimed directly, or indirectly, at the problems of the logger and the millman and toward the efficient use of wood.

Publications made available during past years show diameter cutting limits and other factual information necessary to selective logging in the western white pine type, the ponderosa pine, and the larch-Douglas fir. Another series of publications deals with "residual wood left after logging" in the principal forest types. Sawmill studies made during the past years have provided information on overrun and lumber yields, quantitative and qualitative waste, and the volume and value losses in fire-damaged timber, river-driven logs, and logs transported over gravity chutes. Besides these strictly logging and sawmill studies, departmental bulletins have been published on western larch and white fir with the thought in mind that an understanding of the properties of these two species will increase the demand for them in the lumber market.

During 1939, an area of 200 acres of low-grade mature white pine timber in which heavy losses had been occurring was logged from the Deception Creek Experimental Forest near Coeur d'Alene, Idaho. The operation resulted in removal of 20 percent of the stand, the only trees taken being those which were the least promising and likely to die soon. Lumber yields and values were obtained for a representative sample at the sawmill. Plans are now under way to make further light cuts because the experiment just concluded has demonstrated their practicability. This project is conducted under the joint auspices of the division of forest products and the division of silviculture.

Though ponderosa pine received less attention during the year than white pine, a new bulletin was added to the ponderosa pine list when "The Farm Woodlot," prepared by the division, was published by the University of Montana. Results of other studies were freely drawn upon in other ways, particularly in rendering assistance to the Kootenai and Bitterroot National Forests in establishing light cuts on lands within their province.

Interest in ponderosa pine log grades was revived and a mimeographed resume of the development of ponderosa pine tree and log grades was prepared as an initial step toward Nation-wide standardization of grades. Subsequently, conferences were held with other interested agencies and the end result was that the grades were redefined to iron out discrepancies between regions. The Nation-wide acceptance of these new grades is imminent.

To determine the relative merits of square (sawn) versus round mine timbers, a study was begun which may have far-reaching effects. At present round mining timbers are used extensively, and, since many come from young trees, the residual stand is often left in a poor state. If square timbers can be substituted, many thousands of acres of forest land will be left in a more productive state than heretofore. The aid of the Forest Products Laboratory is being obtained in solving many of the difficult technical problems encountered. Considerable work will be done on this study in 1940.

Wood Preservation Investigations

These have contributed their substantial bit to the efficient use of wood by prolonging its useful life, thus making it possible

for wood to be used in places where competitive materials might otherwise replace it. Each year more and more information is being obtained on the durability of treated and untreated telephone and power poles, fenceposts, mine timbers, and railway ties produced from trees native to the Northern Rocky Mountain region, as well as information on the effectiveness of various wood preservatives and treating processes.

Years of patient research are now yielding their fruits. The division is now in a position where it can forecast with a reasonable degree of accuracy the life expectancy of wood, treated and untreated, exposed to different conditions of service. Thirty years ago the average life of a railway tie was in the neighborhood of 9 years. Today, the life of a similar tie, properly treated, is expected to be 23 years. Such information becomes available because since 1910 the division has made periodic inspections of about 40 different installations, including railway ties, and obtained valuable information therefrom. At present the project has 15 different installations plus 5 which are to be discontinued as soon as the final report on them is prepared.

During the past year 11 installations were inspected and the data resulting therefrom were summarized. In addition, exhibits dealing with wood preservation were prepared for several Montana fairs, and a manual dealing with wood preservation procedures was whipped into final shape and distributed. This manual is intended mainly for use by the Forest Service in Region One, in connection with programs for the construction of high standard communication

systems and range fences within the region. The division had previously contributed instructions which were followed in the treatment of thousands of telephone poles and stubs and hundreds of miles of fenceposts. This manual supplements these previous instructions.

The plans for the coming year include inspections of seven installations, preparation of reports bringing results of all previous inspections up to date, and preparation of two or three articles for publication which will present the results of some of the past studies.

Forest Products Statistics

The maintenance of the current statistical work, revising the statistical publications, and answering inquiries, is no small part of the work program. Many calls are received for up-to-date statistics on the amounts of different products produced, the cost of production, and the sales value.

Production statistics. The purpose of this project is (1) to obtain statistics showing the production of lumber, shingles, lath, and other timber products in Montana, Idaho, and northeast Washington in cooperation with the Bureau of the Census, U. S. Department of Commerce, and (2) to obtain figures on Christmas tree production in western Montana. As a result of past work, lumber production statistics dating back to 1908 have been collected and put into use. Figures on Christmas tree production are available from 1937 to date. The project is continuous.

Selling price statistics. The price statistics gathered by the division supplement the production figures. The series includes stumpage prices (1912 to date); wholesale lumber selling prices (1913 to date); retail lumber selling prices (1922 to date); cedar pole and post prices (1923 to date); railway tie prices and specifications (1920 to date); log prices (1912 to date). The project is continuous.

General Information

In the solution of the more perplexing utilization problems a liaison is maintained with the Forest Products Laboratory, Madison, Wisconsin. These associations were considerably strengthened this past year and in particular by the assignment of T. R. Truax of the Laboratory staff as go-between for the Laboratory and the western products divisions. The usual close associations with the administrative divisions of the Forest Service were continued particularly with the regional division of timber management.

FOREST SURVEY

Although the gathering of data on the present timber situation is the most important and time-consuming phase of the forest survey, its most challenging task is the interpretation of the results of inventory, growth, and drain information to form a basis for recommendations designed to increase the contribution of the forest to the welfare of the American people. This task is much larger than a routine timber cruising and mapping job; its successful accomplishment requires an integrated effort with other governmental units and particularly with other divisions of the Northern Rocky Mountain Forest and Range Experiment Station.

In the problem of determining the current timber-cutting drain on the forests of this region, the survey drew heavily upon the past and present work of the division of forest products which, in cooperation with the U. S. Bureau of the Census, has for many years collected statistics on lumber production. In the realm of forest growth the basic yield tables, used in survey growth calculations, were largely constructed by the division of forest management of this and other stations.

In many of the counties and other political or economic subdivisions of this region the national forests control not only a large proportion of the forest land but in some instances the bulk of all land. In such localities the field officers of the Forest Service actively cooperate with local planning agencies in formulating land-use policies and action plans. The survey with its wealth of basic land-use data in the form of published inventory reports and forest type and land-use maps is contributing much to this important work. These published summaries, however, comprise only a small fraction of the detailed land use and forest descriptive information available in survey files. Recognizing that its data serve best when widest used, the survey stands ready to cooperate as far as funds permit in the further summarizing or resummarizing of its data to meet special needs.

In retrospect, it is plainly evident that the survey in the past has been and still is dependent upon contributions from other divisions of this station; it is therefore truly an all station

project touching the interests of and drawing from all men working on the forest aspects of local research problems. Looking ahead and drawing upon the lessons of the past, it is also clear that we of the survey need to reappraise our job, see it in perspective in relation to the closely allied projects of the station and in relation to the work of other cooperators in the broad field of social and economic planning, both in the Forest Service and outside. Viewed from this angle, the survey is one element in a closely knit research unit attacking the local forest problems in a coordinated effort. The survey organization therefore should strive increasingly to integrate its work more effectively with that of the other elements.

To date survey field mapping and inventory work has been completed on a gross area of 26,782,000 acres in northeastern Washington, northern Idaho, and western Montana. There yet remains a gross area of some 5.5 million acres in western Montana and an estimated forest area of 9 million acres in eastern Montana to be covered with the field inventory. Statistical summaries of inventory data are complete for northeastern Washington and northern Idaho and nearly so for Lincoln County, Montana. Inventory statistics for northeastern Washington and northern Idaho have been published in the form of county reports.

Growth studies are completed for forest lands in northeastern Washington and northern Idaho and are in progress in portions of western Montana. A growth report for northern Idaho is in preparation. Forest drain and requirements studies have been made for the entire

region and reports on these two phases of the work are published.

The survey organization in connection with the comprehensive report on the forest situation in northern Idaho is undertaking its first major job of economic analysis and interpretation. A beginning has already been made in the development of an adequate and practicable system of keeping survey data current.

The immediate objective of the inventory phase of the survey is the completion, during the 1940 field season, if possible, of field mapping and cruising in the portion of Montana lying west of the Continental Divide. Thereafter inventory field work should be carried as rapidly as funds permit to the forest areas in eastern Montana. Simultaneously, growth studies should be completed on areas inventoried so that early reports showing the whole forest resource situation - inventory, growth, drain, and balance of growth and drain - can be prepared for those individual counties in western Montana where the forest is a particularly important contributor to local economic life, and for groups of counties where the relative local importance is less.

Hereafter, the economic analysis and interpretation of survey data and the preparation of comprehensive reports setting forth the results of these interpretations will become an increasingly important phase of survey work. Initial effort will be placed on the northern Idaho report with reports on western Montana and the entire Inland Empire region following in order.

Henceforth, the job of keeping the survey data up to date through the reexamination of areas cut or burned since the date of survey will become more important. It is planned to undertake this work gradually, perfecting the technique, and extending the re-examination over the areas most affected by cutting and fire.

As time passes and the initial phases of survey work are nearing completion, the organization will gradually assume a service function, reanalyzing and interpreting its data in the light of the then current conditions to secure the answer to pressing problems. The survey organization should early recognize its responsibility in this direction and should begin to develop its personnel so that, as the primary phases of inventory and compilation shrink in importance and man power, the nucleus of personnel left is competent to handle this function effectively.

RANGE RESEARCH

Two favorable seasons in sequence, 1938 and 1939, have yielded a rather remarkable recovery of drought depleted shortgrass range at the U. S. Range Livestock Experiment Station and in eastern Montana generally. However, the precipitation at Miles City during these 2 years was only 11.23 and 9.87 inches or 86 and 76 percent, respectively, of the average for the past 62 years. The 1939 season came dangerously near being a distressing year on the range because of a dry winter and spring that extended up till late May to the serious detriment of Sandberg bluegrass and some other early species. Unusually heavy and well distributed June and early July rains saved

the day and enabled such late starters as grama and buffalo grass to make splendid growth and recover a substantial portion of past drought losses. The density of grama made a substantial increase in 1938 and nearly doubled during the past year but is still below its density in 1933. The explanation of recovery during the past 2 years of subnormal precipitation is the timeliness of rains coupled with reduced numbers of livestock for most ranges of eastern Montana.

Deficient spring moisture in 1939 was a great handicap to seedling survival on either native ranges or reseeded areas. The spring of 1938 was far more favorable for seedling survival - the most favorable one for many years past. This long period without a normal crop of seedlings may prove to be a real factor in delaying complete recovery of these ranges to predrought tone. The past two quite favorable seasons, as well as preceding drought years, serve to reemphasize the fact that the drought hazard must be adequately considered in a range research program and in sound land-use planning generally.

The advantage of conservative range stocking was evident again last year in results of the experiment carried the past 7 years in cooperation with the Bureau of Animal Industry and the Montana Station. Average weight of all weaning calves in 1939 prorated to 20 cows on heavily grazed range was 364 pounds as compared to an average of 403 pounds average for weaning weight prorated to the 40 cows on moderately and lightly grazed ranges. At the prevailing price of about 8½ to 8-3/4 cents for such calves, this 39 pounds greater production per

cow was worth $3.22 to $3.41. This is not all, because the cows on overgrazed range required approximately half a ton more supplemental feed during the year and the total feed bill, considering range at 10 cents per acre plus hay at $8 per ton, was $0.98 per head greater than those with a greater acreage of range. Thus, the net advantage of conservative use was more than $4.00 per breeding cow during the relatively favorable 1939 year. During drought years the difference in weaning calf weight has been still greater and the cows on overgrazed range required more supplemental feed, while the risk of forced liquidation of the breeding herd is, of course, increased by heavy use as is the rate of deterioration of cows on inadequate rations for a considerable time each year.

The last two items are difficult to measure in concrete terms, but the relations of calf weight and feed costs is shown by results for this experiment for 7 years. During 6 of the 7 years, 1933 to 1939 (dry heifers used in 1937), the calf crop has been 75, 85, and and 82½ percent and the total weaning calf weight prorated to all cows has averaged 225, 232, and 274 pounds, respectively. The cost of range plus supplemental feed has been 4.7, 3.3, and 3.6 cents per pound of weaning calf weight or 30 to 42 percent higher for the heavily grazed than the lightly or moderately grazed lots. These 6 years include two very severe drought years as well as some relatively favorable seasons.

The slight advantage in calf crop or average weaning weight for moderately grazed range over even the lightly grazed range is not significant by the usual statistical tests. It has, however, been very consistent. These moderately grazed pastures have a somewhat greater proportion of grama grass and less of bluestem wheatgrass. Evidence now points strongly to the fact that range with a relatively high proportion of grama grass will produce heavier calves than on adjoining range where less grama but a greater proportion of bluestem and other grasses makes up the forage supply. It is doubtful if this greater proportion of grama grass is a material factor in the 2½ percent greater calf crop on moderately than on lightly grazed ranges. This slight difference is not significant by usual tests but odds favor it.

The previous practice of using one yearling bull for each of the six pastures was changed in 1939 to one mature bull for the 60 cows in all pastures. At the end of the usual 42- to 45-day breeding period about a quarter of the cows were unbred. Additional bulls were used during the last 10 days of the breeding period and there is some uncertainty whether all cows were bred. Even if the number of calves is not reduced in 1940 by this one bull plan, the variation in age and in weaning weight of calves promises trouble in analysis. The previous plan of using six yearling bulls is thus far more satisfactory. Use of one yearling bull for 10 cows is not necessarily an extra expense because bulls would not be used otherwise until they are 2 years old.

The rapid range recovery has continued to outrun increased stocking of the sheep in experimental pastures. This experiment was started in 1936 when vegetation was at or near the low point of the drought. The planned degree of use has not been reached because of recovery and there has been no consistent relationship between weight gains of yearling ewes and amount of forage available in different pastures. Best efforts have not succeeded in getting satisfactory distribution of sheep and uniform range utilization. One reason for uneven use is excess forage available. With continued upward trend in forage production, substantially heavier stocking is called for before the experiment will yield results within any reasonable time. This might be done by grazing all pastures, say during the winter when sheep are not present, by horses or cattle or by reducing the size of the various pastures. Another alternative is to drop the larger pasture and stock each of the smaller ones with about 75 sheep each and continue with one less intensity of use in the series. Under all the circumstances this seems the proper course to follow.

Results of some promise have begun to show from efforts made during the past three seasons to develop a method for measuring in an objective manner range utilization on both cattle and sheep ranges. Better results have been obtained generally on cattle than on sheep range because of uneven utilization and light stocking on the latter. Variations in utilization on cattle range at varying distances out from the central Lone Pine well that cannot be detected by any other

known method have been measured and expressed in definite percentages that appear to warrant considerable confidence in the method. At the Custer Flat sheep pastures a somewhat similar result has been obtained in comparisons along heavily grazed fence areas with some areas obviously grazed more lightly. Considerable ingenuity and further testing will be required to refine the method into a useful tool that will be rapid enough for practical administrative use. However, this objective now appears somewhat nearer to realization. Certain key species, such as bluestem wheatgrass and Carex, appear to lend themselves better than grama to the method on cattle ranges while grama and Carex seem to be better key species on the sheep range.

The development of utilization standards based on complex factors such as resistance of different species to varying time and degree of use is a slow process. Clipping studies and plant vigor and development studies are being carried at Vigilante and Miles City that will contribute to a determination of utilization standards that must be set up to supplement any methods of measuring utilization.

Montana leads in artificial range reseeding with 35,000 acres reseeded in 1939 by ranchers of the state and 76,000 acres in the preceding 3 years, according to a recent AAA report. From other sources it is learned that public land-managing agencies, exclusive of the Forest Service, reseeded at least 25,000 acres in addition. Crested wheatgrass has been seeded with cheap methods largely in the fall on a major percentage of this large acreage. This is an outstanding example of prompt use of research work of the past few years which has provided rough guides as to the most promising species

and cheap methods for such a program. In addition to crested wheatgrass, the early tests of comparatively few species indicated that smooth brome, tall oat, mountain brome, Ladak alfalfa, and Canada bluegrass, and possibly a few others, have a restricted place in a reseeding program. Recent tests with more than 75 additional species at one or more of our four work centers indicate that at least three additional grasses may have a real place in a reseeding program, where competition with existing vegetation must be successfully met. Numerous other species justify further adaptation studies even though preliminary results are not very encouraging for most of them.

Interest in reseeding burns from the air has continued to grow inside the Forest Service as well as among the general public, with the knowledge that this means has been successfully used in California and Oregon, and has been recently tried by other agencies in Idaho, Montana, and elsewhere. A local flying service has expressed willingness to adapt a ship for such a project. A portion of the necessary funds was available by the station for a test of the method, but the region felt unable to provide about 1,000 pounds of seed needed for a Bitterroot burn of about 200 acres. The Forest Service is in a particularly favorable position to utilize this method for wild lands if the questions of costs and practicability can be resolved in favor of reseeding burns from the air. A special problem is presented in developing equipment that will serve for reseeding at a reasonable cost on unplowed, rocky, steep, or brush-covered wild lands.

A preliminary test was made at Miles City last spring to compare the grazing value of crested wheatgrass with a nearby native range area. The yearling steers utilized the nearly pure stand of crested wheatgrass to a satisfactory degree and gained through most of May and June at the rate of 1.43 pounds per day as compared to 1.71 pounds per day for similar steers on the native-bluestem, grama, buffalo, Sandberg bluegrass range. When converted to a per-acre basis, the gains on crested wheatgrass were 29.87 pounds as compared to 12.85 pounds per acre on native range. These results are indicative but further tests are now possible and will be necessary before reliable conclusions will be possible from such a comparison. A great deal of research will be required to determine the real grazing value, time of use, class of livestock, etc., considered, for crested wheatgrass and for other newer species that successfully pass the range adaptation tests.

Range research methods that will satisfactorily measure response of the extremely variable vegetation with which we deal continues to be a major problem. Some progress has been made in 1939 toward basic improvements in technique and procedures. A "plot transector" devised in 1938 has been tested in some detail and provides one improvement that is not only more objective but more rapid in measuring certain plant responses to weather and treatment. Certain species lend themselves to this device better than others. The growth form of certain species of the plains ranges - buffalo grass in particular - has proved extremely difficult to measure in a satisfactory manner. Further efforts to improve methods for basic

research is particularly urgent, especially for certain growth forms that are common in plains type of vegetation that present special difficulties.

No major change is contemplated in the range program for 1940 unless threatened and drastic reductions in funds require it. The cattle range phase of the management project at Miles City continues to yield cumulative data of particular interest from the economic viewpoint, but certain adjustments are called for to overcome obstacles encountered in the experimental setup for the sheep range phase of this project. A method for measuring utilization deserves further attention this year. Range management research at Vigilante must continue on a limited basis with present funds, but certain studies of plant vigor and development are beginning to yield information of value on this summer range. If the promised CCC spike camp at Vigilante is available the coming season, more work can be done on these studies and certain needed physical improvements can also be accomplished.

Methods of field planting for range species and mixtures, that have shown promise from adaptation tests, will be stressed. Equipment suitable for use on rocky, brushy slopes is needed. Seeding burns from the air deserves some attention in proper relation to other method phases of work. Data on 6 years' work in artificial revegetation are being summarized for publication as a Farmers' Bulletin. A manuscript is being written for a technical bulletin to show the extent to which drought is a major factor in range management and to outline certain practices that help to minimize this handicap. Certain other phases of our program are approaching the point where preliminary data warrant publication as journal articles and station papers.

FLOOD CONTROL SURVEYS

Pursuant to the Flood Control Act of June 22, 1936, and subsequent acts, the Department of Agriculture commenced a program of flood control surveys on various specified watersheds throughout the country. This station was assigned responsibility for two field flood control coordinating committees, one covering the Upper Missouri River, the other covering some of the drainages of the Upper Columbia River basin.

During the past year work authorized by Congress has been continued. The station participated in a second joint hearing on the Colville River drainage, a meeting on the St. Regis River drainage, and several meetings of the field coordinating committee. The station also collaborated with representatives of the Soil Conservation Service and the Bureau of Agricultural Economics in the preparation of a survey work outline for the Spokane River drainage. A second draft of this outline has been completed. Some information has been collected on flood damage and other data on the Clarks Fork and Kootenai Rivers and on the broad problem of the relationship between vegetative cover and run-off. Because of inadequate funds, only incidental work has been done on the Upper Missouri River.

Plans for the first half of 1940 call for completing preliminary examination reports on the St. Regis and Flathead River watersheds in Montana and completing for early submission the final draft of the survey work outline for the Spokane River drainage in Washington and Idaho. Information on other drainages in the committee areas assigned to this station will be obtained as opportunities to secure it occur. Plans for work after the end of the current fiscal year are indefinite because funds are available only until June 30, 1940.

HARVEST CUTTINGS - WESTERN WHITE PINE

FIELD DIVISION: Forest Management Research

WORK PROJECT: Silviculture

LINE PROJECT: Harvest Cuttings (western white pine type).

PURPOSE OF WORK: To develop methods of cutting through investigation of controlling factors that will result in adequate natural regeneration of desired species.

REVIEW OF PAST WORK: Much of the station's silvicultural program since its beginning has centered around methods of cutting and natural regeneration. Various studies of cutting methods, seed supply, seed germination, initial survival, establishment, and early development have been made and reported upon from time to time in numerous publications and station manuscripts. The results of most of these studies have been brought together in comprehensive fashion in "Natural Regeneration in the Western White Pine Type," now in the process of publication as a U. S. Department Agriculture technical bulletin. With the completion of this manuscript, several of these studies have been closed and the way cleared for new studies and a critical evaluation of further research needs in this field. A start in this direction is a study of the economics of managing western white pine forests, built around the North Fork of the Coeur d'Alene River as a case unit, of which field work and part of analysis were completed during 1938. Of new work, in addition to the economic study, greatest emphasis has been placed on studies of stand development during the early and formative years. In cooperation with other agencies, a preliminary study of root diseases in western white pine has been completed.

PROJECT STATUS SHEETS

ACCOMPLISHMENTS DURING PAST YEAR:

1. Post editing of "Natural Regeneration in the Western White Pine Type" was completed and it is now on its way to publication.

2. Real progress in evaluating and orienting silvicultural research needs in white pine has resulted from the economic management study. A first draft of the report on this study has been completed and a short paper on certain aspects of it has been submitted for publication in Northwest Science.

3. Station paper no. 1, "A Preliminary Study of Root Diseases in Western White Pine," by John Ehrlich of the University of Idaho was released as a mimeographed station report summarizing a longer file report covering the cooperative root disease study.

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4. Additional field work in early stand development involving the remeasurement of 18 permanent plots has strengthened the knowledge of this important period of the stand.

5. In cooperation with the division of products, a light selection cutting to remove dead, dying, and poor vigor trees was carried out in the Deception Creek Experimental Forest providing worthwhile information on light cutting possibilities in western white pine. A small sales program was carried out in the Priest River Experimental Forest.

PLANS FOR 1940: 1. Continue the analysis of past silvicultural research in relation to silvicultural problems and research needs of the region. With this as a background, prepare a plan pointing the way of future silvicultural research.

2. Prepare "show-me" material for silvicultural projects under way at the Deception Creek and Priest River Experimental Forests.

3. Complete economic study.

4. Complete a group of papers on phases of early stand development.

5. Round out field work for the study of early stand development.

6. Prepare working plan and begin field work on a study of effects of burning on white pine soils.

7. Cooperate with blister rust organization in the preparation of a report covering blister rust in the management of western white pine.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: C. A. Wellner, K. P. Davis (research planning and economic aspects).

STAND IMPROVEMENT - WESTERN WHITE PINE

FIELD DIVISION: Forest Management Research

WORK PROJECT: Silviculture

LINE PROJECT: Stand Improvement (western white pine type).

PURPOSE OF WORK: To develop cultural measures which will improve the quality and growth of immature stands.

REVIEW OF PAST WORK: Studies of intermediate cuttings were begun in 1914 with the establishment of a series of thinning plots. Work was continued in a more or less desultory fashion until 1933 when, with the establishment of the Deception Creek Experimental Forest and availability of emergency funds, a moderate program of stand improvement was undertaken. Fairly extensive work was also done by the administrative organization. In 1936 available information on stand improvement practices was assembled in a mimeographed manual, "Stand Improvement Practice in the Western White Pine Type," accepted by administration as standard instructions for this class of work.

In 1938, in cooperation with Region One, a rather comprehensive summary of stand improvement work done in both western white pine and ponderosa pine was made. All information available, plus additional silvicultural data obtained in the field was systematically assembled in unit reports which will furnish a factual basis for an appraisal of results obtained.

Periodic remeasurements are made on the following: 20 permanent plots in young stands of less than pole size, 39 permanent plots in pole-sized stands (one of these is the subplot latin square), four girdling plots, and eight small pruning plots.

ACCOMPLISHMENTS DURING PAST YEAR:

1. Preparation of unit reports complete with maps on stand improvement summary project and limited distribution to administration of a brief summary of outstanding conclusions.

2. Continued extension work with administrative organization to check applicability of present methods and to suggest improvements in technique.

3. Remeasurement of 16 thinning and 3 cleaning plots. Partial analysis of all and preparation of a progress report on cleaning plots for release as a station research note.

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4. An extensive thinning of 25 acres in replicated and randomized blocks, mainly to release western red cedar in the Priest River Experimental Forest, and a 20-acre cleaning project on the Deception Creek Experimental Forest.

PLANS FOR 1940: 1. Continue extension work with administrative organization. 2. Prepare article for Journal of Forestry summarizing stand improvement in Region One. 3. Revise and reissue stand improvement manual. 4. Complete analysis and prepare for release three research notes summarizing data obtained on permanent thinning plots. 5. Remeasure 13 cleaning and 6 permanent thinning plots. 6. Continuation of extensive stand improvement work at Priest River.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: K. P. Davis.

STAND IMPROVEMENT - PONDEROSA PINE

FIELD DIVISION: Forest Management Research

WORK PROJECT: Silviculture

LINE PROJECT: Stand Improvement (ponderosa pine type).

PURPOSE OF WORK: To develop cultural measures which will improve the quality and growth of immature stands.

REVIEW OF PAST WORK: Twelve plots to test different weights of thinning established on the Lolo National Forest during 1933 in a 50-year-old ponderosa pine stand. Three additional thinning plots established on the Lolo National Forest in a 30-year-old stand during 1935.

ACCOMPLISHMENTS DURING PAST YEAR: 1. Preparation of a 5-year progress report for release as a station research note summarizing results for 1938 remeasurement of 1933 series of thinning plots.

2. An extensive test of pruning ponderosa pine on more than 300 acres in the Priest River Experimental Forest.

PLANS FOR 1940: Remeasurement of the three 1935 Lolo thinning plots and preparation of a progress report on them.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: K. P. Davis.

STAND STUDIES - WESTERN WHITE PINE

FIELD DIVISION: Forest Management Research

WORK PROJECT: Mensuration

LINE PROJECT: Stand Studies (western white pine type).

PURPOSE OF WORK: To determine composition, growth, yield, and mortality in western white pine stands.

REVIEW OF PAST WORK: 1. Type-wide study of growth and yield in fully stocked natural stands. (Published as U. S. Department Agriculture technical bulletin 323.)

2. Establishment and periodic remeasurement of 34 permanent and 54 semipermanent yield plots in natural stands.

3. Increment and mortality observations of the residual stand on 24 permanent plots in cutover, mature, and overmature stands. Ten-year records available for nine of these plots showed a consistent loss of the residual stand in net volume amounting to 20 percent the first decade, substantiating the observation that old white pine stands have a tendency to deteriorate following a partial cutting.

4. Type-wide study of increment and mortality in cut-over stands using temporary plot technique. Field work done in 1928, 1937, and completed in 1938.

ACCOMPLISHMENTS DURING PAST YEAR: Extensive compilation work was done on the cut-over area study. Mortality data were compiled and analyzed; diameter, basal area, cubic volume, and board-foot growth were tabulated and summarized. The project is now ready for final analysis and report writing.

PLANS FOR 1940: Remeasurement of 25 semipermanent and 3 permanent yield plots in natural stands and 2 plots in cut-over stands. Preparation of a comprehensive publication bringing together the results of the 1928, 1937, and 1938 cut-over area studies, together with information from permanent sample plots in cut-over stands, is now scheduled for the winter of 1940-41.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: K. P. Davis.

STAND STUDIES - PONDEROSA PINE

FIELD DIVISION: Forest Management Research

WORK PROJECT: Mensuration

LINE PROJECT: Stand Studies (ponderosa pine type).

PURPOSE OF WORK: To determine composition, growth, yield, and mortality of stands of the ponderosa pine type.

REVIEW OF PAST WORK: A total of 186 temporary yield plots established in even-aged stand during the period 1932-34 as part of an interregional growth study. Data turned over to the Pacific Northwest Station which prepared technical bulletin no. 630, "Yield of Even-Aged Stands of Ponderosa Pine," in 1938. About 110 of temporary plots selected for remeasurement as semipermanent yield plots. Six permanent yield plots in Lolo National Forest measured periodically.

ACCOMPLISHMENTS DURING PAST YEAR: None.

PLANS FOR 1940: None.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: K. P. Davis.

STAND STUDIES - LARCH-DOUGLAS FIR

FIELD DIVISION: Forest Management Research

WORK PROJECT: Mensuration

LINE PROJECT: Stand Studies (western larch-Douglas fir type).

PURPOSE OF WORK: To determine composition, growth, yield, and mortality of stands of the western larch-Douglas fir type.

REVIEW OF PAST WORK: 1. Measurement of increment and mortality 25-35 years after cutting on 86 temporary plots in selectively cut stands. Most of office compilations made and preliminary report prepared. Final report for publication yet to be prepared.

2. Four permanent yield plots established during last 25 years in fully stocked natural stands.

3. Yield study of even-aged stands made by forest survey taking data on 150 temporary plots. Of these 42 have been selected for remeasurement as semipermanent yield plots.

ACCOMPLISHMENTS DURING PAST YEAR: None.

PLANS FOR 1940: Remeasurement of four permanent yield plots. Preparation of report on cutover stands will be prepared during winter of 1940-41.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: C. A. Wellner.

PLANTING

FIELD DIVISION: Forest Management Research

WORK PROJECT: Regeneration

LINE PROJECT: Planting

PURPOSE OF WORK: To develop methods of artificial regeneration which are economically and silviculturally satisfactory.

REVIEW OF PAST WORK: Investigative work in planting and nursery practice started with the establishment of the Priest River Station in 1911 and continued intermittently until 1926. Nursery studies in seedbed densities, season of sowing, and root pruning reported in numerous publications have contributed much to the development of nursery practice. Studies in direct seeding conducted between 1915 and 1921 did not develop a successful method. Results of planting investigations contributed to the development of a successful planting technique and indicated that season of planting had no appreciable effect on survival and that transplant stock was better than seedling stock. An analysis of plantation survival records, 1910-1936, inclusive, showed that spring-planted stock survived better than fall-planted stock and that average survival 10 years after planting was only 42 percent. To determine where improvements in planting practice might be made, investigations were resumed in 1936. A 5-year study of grade and age class of stock, carefulness in planting and handling stock, and early, middle, and late spring planting was started with the station and the regional planting office cooperating and has been continued by the planting office with occasional help and advice from the station. Since 1937 the station has concentrated its efforts on direct seeding. Plots installed in the fall of 1937 and the spring of 1938 show that western white pine, ponderosa pine, and Engelmann spruce can be successfully seeded if protected from rodents during the first year. An arboretum for demonstration, started at the Priest River Station in 1931, now has 45 species in blocks of 1/4 to 1 acre each.

ACCOMPLISHMENTS DURING PAST YEAR: 1. Second-year examinations of the 1937-38 seeding plots showed that (a) satisfactory stocking was maintained after removal of protective screens at the end of the first growing season, with very little mortality; (b) delayed germination increased stocking on spring-sown plots, but fall-sown plots were still superior. Results of these plots were summarized in a mimeographed station report, Applied Forestry Note no. 90, "Direct Seeding in the Western White Pine Type."

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2. First-year examinations on seedings of western red cedar showed that (a) fall sowing was better than spring sowing; (b) good stocking resulted on north slopes where brush competition was absent; (c) failure resulted on exposed flats and on a north slope where brush competition was present.

3. Spot sowings of western white pine, using poisons for rodent control, on two broadcast burned areas of 11 acres and 50 acres, resulted in survival on 85 percent and 69 percent of the spots, respectively.

4. Fail places were planted in several blocks of the Priest River arboretum.

PLANS FOR 1940: 1. Continue direct-seeding studies to find out if both prepoisoning of a seeded area and a poison coating on the seed are necessary, and, if not, which treatment can be eliminated.

2. Determine relative efficiency of broadcast seeding and spot sowing.

3. Determine the relative suitability of Douglas fir and western white pine to seeding methods.

4. Make further tests of western red cedar seeding.

5. Initiate studies on time of seed maturation, quick germination tests; and seed storage conditions.

6. Continue cooperation with planting office on 5-year planting study.

7. Prepare general working plan for forestation research.

DATE OF COMPLETION: Continuing project. Station studies contingent on temporary funds.

ASSIGNMENT: C. S. Schopmeyer.

PHENOLOGY

FIELD DIVISION: Forest Management Research

WORK PROJECT: Silviculture

LINE PROJECT: Silvics (phenology)

PURPOSE OF WORK: To determine seasonal vegetative events of principal trees and shrubs in Region One.

REVIEW OF PAST WORK: Project started in 1928 with phenological observations made by rangers on 18 national forests, at Savenac nursery, Priest River Experimental Forest, Yellowstone, and Glacier National Parks. Observations dropped on 12 forests between 1932 and 1934. At the beginning of 1937 observations were being made at only nine stations. Project terminated in 1937 because the station found it impossible to give adequate technical supervision. Although a large mass of information has been collected, its usefulness is greatly limited by lack of uniformity and thoroughness in making observations. Compilation of the data and preparation of a report summarizing useful information remains to be done.

ACCOMPLISHMENTS DURING PAST YEAR: None.

PLANS FOR 1940: None. Pressure of other work will not permit the making of a final report.

DATE OF COMPLETION: Project terminated except for preparation of final report.

ASSIGNMENT: C. A. Wellner.

GEOGRAPHIC STRAINS

FIELD DIVISION: Forest Management Research

WORK PROJECT: Genetics

LINE PROJECT: Racial variation (geographic strains of ponderosa pine).

PURPOSE OF WORK: To determine suitability of ponderosa pine seed from different sources for planting in northern Idaho; to ascertain heritable characteristics of growth, form, and hardiness developed through adjustment of parents to local climate.

REVIEW OF PAST WORK: Trees grown from seed of ponderosa pine collected in 21 widely separated localities in western United States were planted in plots at the Priest River Experimental Forest from 1911 to 1917. Plots studied and reported upon by Kempff in 1927. Thorough field examination and measurements made in fall of 1935 and analysis made by Weidman. Differences with respect to number of needles to the fascicle, length of needles, general appearance of foliage, and thickening of hypoderm found among progeny groups derived from different regions delimited on the basis of precipitation type. Persistence of needles found not to be hereditary. Pronounced differences found among different progenies in height growth, diameter growth, relation of two, and relative height growth by years. Best growth in height and diameter made by trees derived from localities which in climate resemble locality of planting site. As sources of seed for planting in northern Idaho, experiment indicates trees of North Pacific region unsuitable because of low frost resistance, those of Black Hills and southeastern Montana questionably suitable because of early decline in growth rate, those of Central and South Plateaus and Colorado decidedly unsuitable because of distinctly poor rate of growth. Findings to date indicate most suitable general territory in which to collect ponderosa pine seed for northern Idaho use extends from Colville locality in Washington eastward a little beyond Continental Divide and from Salmon River to Canadian boundary. Manuscript "Racial Influences in a 25-Year Test of Ponderosa Pine" by R. H. Weidman submitted in September 1937 for publication in Journal of Agricultural Research.

ACCOMPLISHMENTS DURING PAST YEAR: Manuscript described above accepted for publication and in galley form at close of 1939. A summary of this manuscript has been prepared to be released as a station mimeographed note for local distribution.

PLANS FOR 1940: 1. Publication of reports described above.
2. Remeasurement of progeny plots.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: C. A. Wellner.

BEHAVIOR OF FIRES

FIELD DIVISION: Forest Management

WORK PROJECT: Fire Protection

LINE PROJECT: Behavior. Daily and seasonal variables.

PURPOSE OF WORK: To determine the relation between meteorological elements and inflammability of the fuels of forest fires, including the factors of inflammability and how each may best be measured. Involves (1) what to measure; (2) how to measure; (3) where to measure; (4) when to measure; and (5) how to integrate these measurements into a practical scale of inflammability and fire danger.

REVIEW OF PAST WORK: Started in 1922. Five major factors determined; duff hygrometer, wood cylinders, and low-cost anemometer invented, and fire danger meter for integrating factors designed by 1931. Tested on 10 forests for 4 years. Model 4 danger meter made official in 1935. Model 5 used in 1938 and 1939. Misc. pub. no. 29, 1928, circ. no. 398, 1936, and several articles describe techniques. Rating of character of past fire season issued annually for last 6 years for benefit of federal, state, and private timber protective organizations.

Concentrated study of altitude and aspect was commenced in 1935 to discover better where and when to measure. Chemical studies of the moisture, chemical, and calorific content of growing vegetation were commenced in 1935 and dropped for lack of funds in 1939.

ACCOMPLISHMENTS DURING PAST YEAR: Reports on "The Effect of Certain Chemical Attributes of Vegetation on Forest Inflammability," and "Influence of Altitude and Aspect on Daily Variations in Factors of Forest Fire Danger" edited and accepted for publication. Statistical analysis of daily ratings from 10 forests for 6 years commenced.

PLANS FOR 1940: Test findings from altitude and aspect to determine if results hold true in other parts of the region under other differences of altitude from valley bottom to mountain top. In preparation for recasting of objectives and methods Gisborne should spend at least 2 months with regional forester and fire chief on field inspection. Continue only skeleton of essential routine work at Priest River Experimental Forest. Development of greatly needed fire behavior and fire dispatcher meters contingent upon funds.

DATE OF COMPLETION: Unknown.

ASSIGNMENT: H. T. Gisborne,
G. L. Hayes on Altitude and Aspect phase.

PRESUPPRESSION, DETECTION, SUPPRESSION

FIELD DIVISION: Forest Management

WORK PROJECT: Fire Protection

LINE PROJECT: Control, fire control planning

PURPOSE OF WORK: To determine the principles, methods, and procedures that will furnish adequate man-power and facilities for fire control at least cost in accordance with local values at stake, occurrence of fires, and fuel types.

REVIEW OF PAST WORK: Started in 1931 and prosecuted actively through 1935, with great assistance from the regional office in funds and personnel. Planning methods evolved and applied by region on 17 national forests comprising 23 million acres, and on national park and private forest lands. Progress report, "Fire Control Planning in the Northern Rocky Mountain Region" multilithed in 1936. Success of these methods in Region One resulted in Nation-wide application with local modifications. "Hornby's Principles of Fire Control Planning" published in the Journal of Forestry, April 1939.

ACCOMPLISHMENTS DURING PAST YEAR: In accordance with plans for 1939, to check existing fuel type standards, one man studied actual rates of spread on about 40 fires and commenced the analysis of the records of about 2,000 fires coded on the punch cards to show size at discovery and at arrival, elapsed time, fuel type, and danger class. This work was completely financed by the regional office division of fire control.

PLANS FOR 1940: Rate-of-spread studies dependent upon ability of the regional office to continue to finance this work. Prepare "Fuel Reduction Manual" along lines of Misc. Circ. No. 15 of the National Park Service.

DATE OF COMPLETION: Five years' work needed with increased funds.

ASSIGNMENT: H. T. Gisborne, for general supervision.

LOGGING AND MILLING INVESTIGATIONS

FIELD DIVISION: Forest Products

WORK PROJECT: Timber Harvesting and Conversion Investigations

LINE PROJECT: Logging and Milling

PURPOSE OF WORK: The work divides into three parts: (1) Combination woods-and-mill studies which provide information on the quantity, grade, and value of lumber produced by trees of difference sizes and grades, the cost of producing the lumber, and the size and grade of tree which it is profitable to utilize. (2) Woods studies which provide information on logging outputs and utilization. (3) Sawmill and manufacturing-plant studies which supply information on overrun, grades of lumber produced by logs of different sizes and grades, the cost of sawing, the efficiency of various plant machinery, the waste occurring in manufacture, etc.

REVIEW OF PAST WORK: Publications now available show diameter cutting limits and other information necessary to selective logging in the (1) western white pine type, (2) ponderosa pine type, and (3) larch-Douglas fir type. In addition, log and tree grades have been developed locally to facilitate application of the principles deduced from the studies. Also, numerous logging output and "residual wood left after logging" studies have been made in the important forest types. In the sawmill, studies conducted during the past 15 years have made available information on the average overrun of lumber over log scale for all commercial species, quantitative and qualitative waste, and the volume and value losses in fire-damaged timber, river-driven logs, and logs transported over gravity chutes.

ACCOMPLISHMENTS DURING PAST YEAR: Light Cuts in White Pine. An area of 200 acres of low-grade mature timber in which heavy losses have been occurring was logged from the Deception Creek Experimental Forest. The operation resulted in removal of 20 percent of the stand, an unusual procedure for white pine, and one which heretofore had been regarded as impractical. The only trees taken were the least promising and those which were likely to die soon. Lumber yields and values were obtained for a representative sample in a study at the sawmill. Plans are now under way to make further light cuts because the experiment just concluded has demonstrated their practicability.

A similar light cut made in 64-year-old timber whetted the interest of the Kaniksu Forest and they now contemplate a commercial sale, with the stand being cut over lightly. A publication telling the possibilities of light cuts in young white pine is now being distributed (January 1940).

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Light Cuts in Ponderosa Pine. During the year a bulletin on "The Farm Woodlot" was published and distributed. No new experiments were initiated, but the results of past studies were freely drawn upon in rendering assistance to the Bitterroot and Kootenai National Forests in establishing light cutting practices on land within their province.

Log and Tree Grades. A mimeographed resume of the development of ponderosa pine log and tree grades at the station was prepared as an initial step toward Nation-wide standardization of grades. Subsequently, a conference was held at Berkeley and another at Portland, at which log grades for ponderosa pine were standardized. The Nation-wide acceptance of these is imminent.

Square (sawn) versus round mining timbers. A study was begun to determine the relative merits of sawn versus round timbers. At present round timbers are used extensively, and since many come from young trees the residual stand is often left in a depauperate state. If sawn timbers can be substituted, thousands of acres of forest land will be left in more productive condition than heretofore. The aid of the Forest Products Laboratory is being obtained in solving many of the difficult technical problems encountered.

PLANS FOR 1940: (1) Continue study of light cuts in western white pine with particular emphasis on preparation of a logging plan for the Deception Creek Experimental Forest.

(2) Continue investigation of merits of sawn versus round mining timbers in cooperation with the Forest Products Laboratory.

(3) Assist E. T. Wohlenberg (division of private forestry) in a contemplated logging and milling study in South Idaho (estimated time, 2 weeks) and do the same for the regional office of timber management in a contemplated study of ponderosa pine at Libby, Montana.

(4) Study knot development and its effect on the lumber quality of ponderosa pine, if time is available.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: E. F. Rapraeger.

PROPERTIES AND USES OF MINOR SPECIES AND PRODUCTS

FIELD DIVISION: Forest Products

WORK PROJECT: Timber Harvesting and Conversion Investigations

LINE PROJECT: Properties and uses of the little-used species and the properties and uses of products other than lumber.

PURPOSE OF WORK: To provide information on the available supply, quality, and suitability for specific uses of the little-used species (western larch, Douglas fir, Engelmann spruce, lodgepole pine, western red cedar) and the properties and uses of forest products other than lumber.

REVIEW OF PAST WORK: Departmental bulletins have been published on western larch and white fir, respectively. Prior to 1933, about half the work necessary for a bulletin on lodgepole pine had been completed when the urgency of work in connection with the requirements and depletion phase of the forest survey compelled temporary suspension of activity.

ACCOMPLISHMENTS DURING PAST YEAR: Two pamphlets were prepared telling about the utilization of western Montana forests for Christmas trees.

PLANS FOR 1940: If time permits, some work will be done on lodgepole pine by putting what information is available in usable shape. Time permitting, help will be extended to the Forest Products Laboratory in a study of the significance of the variations in the color of cedar heartwood and its influence on commercial use. Some work may be done, in cooperation with the Madison Laboratory or private agencies, in determining the suitability of western larch for plywood.

DATE OF COMPLETION: Continuous project.

ASSIGNMENT: C. N. Whitney, E. F. Rapraeger, in cooperation with the Forest Products Laboratory.

DURABILITY OF WOOD - TREATED AND UNTREATED

FIELD DIVISION: Forest Products

WORK PROJECT: Wood Preservation Investigations

LINE PROJECT: Service Test Records

PURPOSE OF WORK: To provide information on: (1) the durability of treated and untreated telephone poles, fence posts, ties, and other timbers produced from timber trees native to the Northern Rocky Mountain region; and (2) the comparative value of various wood preservatives and treating processes.

REVIEW OF PAST WORK: Periodic examinations of wood used in various forms have been made since 1910 on about 40 installations. At present the project has 15 active installations including telephone and power poles, fence posts, mine timbers, and ties scattered widely throughout Montana, plus five which are to be discontinued as soon as the final report on them is prepared.

ACCOMPLISHMENTS DURING PAST YEAR: Exhibits dealing with wood preservation were prepared for several Montana fairs in cooperation with the regional division of information and education, and a manual dealing with wood preservation procedure was prepared in cooperation with the regional division of engineering.

Eleven installations were inspected in company with R. M. Wirka of the Forest Products Laboratory, and the data resulting from the inspections were summarized. While in Missoula, Wirka reviewed the office records of the various projects and made recommendations covering various phases of the work.

PLANS FOR 1940: Inspect the following installations: Two telephone lines, three railway-tie test tracks, and two fence-post tests, all in the vicinity of Missoula. Prepare reports bringing results of all previous inspections up to date. In addition, two or three manuscripts presenting results of tests on ties, fence posts, and poles will be completed.

DATE OF COMPLETION: Irregular intervals when no longer useful.

ASSIGNMENT: C. N. Whitney.

MANUFACTURING COST STATISTICS

FIELD DIVISION: Forest Products

WORK PROJECT: Forest Products Statistics

LINE PROJECT: Manufacturing cost statistics - logs and lumber.

PURPOSE OF WORK: To obtain detailed logging and lumber manufacturing costs from the larger lumber companies in western Montana, northern Idaho, and eastern Washington by personal contact. The information is used in appraising national forest timber and in logging and milling studies.

REVIEW OF PAST WORK: Detailed lumber production costs are now available from 1916 to 1938, inclusive. This is probably the most complete series available in the United States.

ACCOMPLISHMENTS DURING PAST YEAR: Costs for 1938 were obtained as usual in the early part of 1939. The weighted average cost of lumber manufacture for the year of $14.39 per M (sawmill pond to freight car) was the highest reported for any of the 23 years for which costs are available. The increase is due in part to social security taxes and to fixed costs which increased because of curtailed production.

PLANS FOR 1940: Obtain the costs for 1939 and continue the project.

DATE OF COMPLETION: Continuing indefinitely.

ASSIGNMENT: P. Neff, regional logging engineer - field work. E. F. Rapraeger - field work. Marie Bouchard - office compilation.

PRODUCTION STATISTICS - LUMBER AND OTHER PRODUCTS

FIELD DIVISION: Forest Products

WORK PROJECT: Forest Products Statistics

LINE PROJECT: Production Statistics

PURPOSE OF WORK: (1) To obtain statistics showing the production of lumber and other timber products in Montana, Idaho, and northeastern Washington in cooperation with the Bureau of the Census, Department of Commerce. (2) Obtain statistics showing the production of Christmas trees in western Montana.

REVIEW OF PAST WORK: As a result of work done by this station in the past, lumber production data from 1906 to the present time have been made available to the public. Figures on the production of Christmas trees are available from 1937 to date.

ACCOMPLISHMENTS DURING PAST YEAR: The lumber census was completed slightly earlier than usual and preliminary figures on production were published. These showed that in 1938 the large gains in volume of lumber production reported annually from 1933 to 1937 for Montana and Idaho were largely offset by a decline which caused the combined lumber output of these states to drop from 1,132,537 M feet for 1937 to 792,150 M feet for 1938. Lath production decreased 37 percent to a figure of 77,586 M pieces (1938) for the two states. The records show that the upward trend in shingle production, recorded for each year from 1933 to 1937, was not interrupted. The production was 40,086 squares in 1938 compared with 38,588 in 1937.

Figures on Christmas tree production in 1938 were obtained as usual. Production amounted to 1,676,000 trees or about one-sixth of the national consumption. It is probable that the figures for 1939, when they become available, will show the largest production in history.

PLANS FOR 1940: Continue the project.

DATE OF COMPLETION: Continuing project.

ASSIGNMENT: C. N. Whitney,
Marie Bouchard.

SELLING VALUE STATISTICS - LUMBER AND OTHER PRODUCTS

FIELD DIVISION: Forest Products

WORK PROJECT: Forest Products Statistics

LINE PROJECT: Selling price statistics.

PURPOSE OF WORK: To collect and present in usable form lumber and timber products price statistics for eastern Washington, northern Idaho, and Montana in sufficient volume to indicate periodic trends in selling price of lumber (wholesale and retail), stumpage, logs, cedar products, and ties. These data are used in appraising the stumpage value of timber sold from Forest Service and Indian Service lands of the Inland Empire.

REVIEW OF PAST WORK: Publications now available show (1) stumpage prices by species for each year since 1912; (2) average annual wholesale lumber selling prices for each year since 1913 for the commercially important species of the Inland Empire. In addition, unpublished records are available which show the selling price of (1) sawlogs, 1912 to date; (2) cedar posts and poles, 1923 to date; (3) railway ties, 1920 to date; and (4) retail lumber, 1922 to date.

ACCOMPLISHMENTS DURING PAST YEAR: Each of the six price series were kept up to date. The two publications showing wholesale lumber selling prices and stumpage prices were revised to include 1938 figures, and, in addition, an article pertaining to 1938 log prices was published. For 1939 and future years, log prices will be obtained from the Division of Forest Economics (Washington, D. C.) in compliance with a recent arrangement. Another development was that the Western Pine Association, the source of the wholesale lumber prices, will furnish this information quarterly as well as on a monthly basis as in the past. Another change is that retail lumber prices are being compiled semiannually instead of quarterly as heretofore.

PLANS FOR 1940: Continue the various compilations.

DATE OF COMPLETION: Continuing indefinitely.

ASSIGNMENT: Marie Bouchard.

INVENTORY PHASE OF FOREST SURVEY

FIELD DIVISION: Forest Survey

WORK PROJECT: Forest Survey

LINE PROJECT: 1. Inventory Phase of Forest Survey in the Northern Rocky Mountain Region.

PURPOSE OF WORK: A comprehensive inventory of the forests of this region as part of the forest survey of the Nation.

REVIEW OF PAST WORK: Field work on this project was started in 1932. Prior to January 1, 1939, 25 million acres of forest and other land had been covered by the field survey. The distribution of this accomplishment by calendar years is tabulated below. The percentages have no direct relation to the acreages shown, but rather are an estimate of the portion of the total survey job, field work, compilation, report preparation, and all that was completed during a given year.

Year	M acres	Percent	Year	M acres	Percent
1932	511	0.5	1936	637	6.0
1933	955	1.5	1937	3,430	15.0
1934	10,109	10.0	1938	2,160	8.0
1935	7,478	8.0	Total	25,280	49.0

Two-inch-to-the-mile township type maps and 1-inch-to-the-mile unit type maps had been prepared for 18 million acres of this area. Basic statistical data on forest area and timber volumes had been published for the three counties in northeastern Washington and all of the counties in northern Idaho, a total of 13 county reports.

ACCOMPLISHMENTS DURING PAST YEAR: Two-inch-to-the-mile township base maps, as an aid in field mapping, were prepared for Ravalli and Missoula Counties. Field mapping was completed on 1,502,000 acres in Ravalli County, making a total of 26,782,000 acres. Area and volume data for northern Idaho were adjusted for depletion and growth to bring them up to date as of January 1, 1939. Two-inch-to-the-mile township type maps and 1-inch-to-the-mile unit type maps were completed on 4-1/4 million and 3 million acres, respectively. Progress on compilation work in Lincoln County progressed from 20 percent to more than 90 percent during the year. A report was issued entitled "Western Red Cedar Pole Resources in North Idaho and Northeastern Washington" and a beginning made on a report on the forest resources of northern Idaho. It is estimated that the inventory phase is 54 percent completed.

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PLANS FOR 1940: Rapid completion of the text of a comprehensive report on the forest resources of northern Idaho. Concentration of the clerical and drafting personnel on the compilation and drafting work in Lincoln, Sanders, Ravalli, Mineral, Flathead, and Lake Counties, in the order named. Complete field mapping on some 5.5 million acres yet unmapped in the Inland Empire in Missoula, Granite, Powell, Deer Lodge, Lewis & Clark, and Silver Bow Counties. Publication of a complete county report showing data on inventory, growth, and drain for Lincoln and perhaps Sanders and Ravalli Counties.

DATE OF COMPLETION: On the basis of 1940 fiscal year allotments, it is estimated that the regional project will be completed by 1946.

ASSIGNMENT: R. K. Winters, P. D. Kemp, S. B. Hutchison, W. L. Royer, J. M. Honeywell, H. B. Hawk, O. B. Johnson, C. W. Brown, B. W. Newton, R. L. Conn, M. E. Metcalf, H. J. Pissot, P. H. Isaac, and J. B. LaCasse.

January 1940

GROWTH PHASE OF THE FOREST SURVEY

FIELD DIVISION: Forest Survey

WORK PROJECT: Forest Survey

LINE PROJECT: 2. Growth and Yield. Growth Phase of the Forest Survey in the Northern Rocky Mountain Region.

PURPOSE OF WORK: To determine the present annual board foot and cubic foot volume growth for important forest types, age classes, degrees of stocking, principal species, and other classifications, and to estimate potential annual growth.

REVIEW OF PAST WORK: Construction of larch-Douglas fir normal yield table and a cubic-foot volume table for western larch has been completed. Field studies were made to determine the stocking of average stands of the principal forest types in northeastern Washington and northern Idaho in relation to the stocking of normal stands of the same types. Correction factors applicable to normal yield table current growth figures to obtain growth for stands of varying degrees of understocking were worked out for the major forest types in northeastern Washington and northern Idaho. Completed current annual growth calculations for northeastern Washington and about 80 percent of the growth calculations for northern Idaho. Completed field work and practically all of the office work on a study of cedar-pole increment.

ACCOMPLISHMENTS DURING PAST YEAR: The cedar-pole increment study was completed. The current annual growth calculations for northern Idaho were completed and a rough draft of a growth report for this area was completed and partially revised. Field studies were made to determine the stocking of average stands of the principal forest types in Lincoln, Sanders, Mineral, and Ravalli Counties, Montana, in relation to the stocking of normal stands of the same types. Computations on this stocking correlation study were about 30 percent completed at year's end. Correction factors applicable to normal yield table current growth figures to obtain growth for stands of varying degrees of understocking were worked out for the major forest types in western Montana.

PLANS FOR 1940: Complete the revision and publication of growth report for northern Idaho. Complete the computations on the stocking correlation study in Sanders, Ravalli, and Mineral Counties and extend the field work of this study to other counties in western Montana, if necessary. Carry out the calculations necessary for estimating current annual growth for Lincoln, Sanders, Ravalli, Mineral, and Flathead Counties in the order named.

DATE OF COMPLETION: On the basis of 1940 fiscal year allotments, it is estimated that the regional project will be completed about 1944.

ASSIGNMENT: R. K. Winters, P. D. Kemp, C. W. Brown, H. B. Hawk.

A STUDY OF FOREST DEPLETION FROM ALL CAUSES

FIELD DIVISION: Forest Survey

WORK PROJECT: Forest Survey

LINE PROJECT: 3. Depletion. A study of forest depletion from all causes in the Northern Rocky Mountain region.

PURPOSE OF WORK: To determine as part of the Nation-wide forest survey the average annual forest depletion from cutting, fire, insects, and disease within the region.

REVIEW OF PAST WORK: Data on average annual cutting depletion for the period 1925-1934 or thereabouts were collected, compiled, and published for the entire region. Supplemental compilations of lumber depletion were compiled for the years 1935, 1936, and 1937. Data on average annual fire depletion for three counties in northeastern Washington compiled, and about 60 percent completed for northern Idaho, and a start made in western Montana. Determination of epidemic insect depletion in northern Idaho approximately 50 percent completed.

ACCOMPLISHMENTS DURING PAST YEAR: Current insect, fire, and disease losses for northern Idaho completed. Fire depletion was summarized for Lincoln and Sanders Counties, Montana. Data on lumber cut for 1938 partially collected.

PLANS FOR 1940: Calculate the depletion resulting from fire, insects, and disease in those Montana counties where it is necessary to bring survey volume data up to date of report publication. Keep current records of lumber cut.

DATE OF COMPLETION: A continuing project.

ASSIGNMENT: R. K. Winters, P. D. Kemp, S. B. Hutchison, and J. M. Honeywell.

STUDY OF PRESENT AND FUTURE REGIONAL REQUIREMENTS FOR FOREST PRODUCTS

FIELD DIVISION: Forest Survey

WORK PROJECT: Forest Survey

LINE PROJECT: 4. Requirements. A study of present and future regional requirements for forest products.

PURPOSE OF WORK: As a part of the national forest survey to determine the current needs for forest products based on present consumption and the trends in use of such products and the underlying causes for such trends.

REVIEW OF PAST WORK: Collected basic data concerning requirements of timber products by railroads, remanufacturing industries, highway departments, public utilities, the mining industry, federal agencies, counties, states, and for farm and urban construction, including also the consumption of fuelwood and fenceposts. Analysis of basic data nearly completed and report preparation begun.

ACCOMPLISHMENTS DURING PAST YEAR: Completed analysis and report published.

PLANS FOR 1940: Project completed.

ECONOMIC ANALYSIS OF FOREST SURVEY DATA IN REPORT FORM

FIELD DIVISION: Forest Survey

WORK PROJECT: Forest Survey

LINE PROJECT: 5. Interpretation. An economic analysis of forest survey data in report form.

PURPOSE OF WORK: To make an economic analysis of all survey data and prepare final reports by economic units and regions.

REVIEW OF PAST WORK: Preliminary and general analyses made in the forest survey county reports released in connection with the inventory phase. Necessary compilation of inventory and work on requirements, depletion, and growth brought into final stages for northern Idaho. Rough draft of a comprehensive report on the forest resources of northern Idaho begun.

PLANS FOR 1940: Gather additional economic data needed for forest resources report for northern Idaho. Prepare northern Idaho forest resources report covering all phases of the forest survey.

DATE OF COMPLETION: Complete northern Idaho forest resources report 1940. Prepare during 1940 a report for Lincoln, and perhaps Sanders and Ravalli Counties, Montana, showing forest area and volume statistics and growth and depletion data. Completion date of other reports indefinite.

ASSIGNMENT: R. K. Winters, forest survey staff.

MANAGEMENT SHORT-GRASS RANGES

FIELD DIVISION: Range Research

WORK PROJECT: Grazing Management

LINE PROJECT: Management Short-grass Ranges

PURPOSE OF WORK: Determine best range utilization and management practices for both cattle and sheep, vegetation and economics of production both considered.

REVIEW OF PAST WORK: Experiment started in 1932 with 60 cows divided equally into three lots, heavily, moderately, and lightly grazed. Total vegetal density reached low point early in 1937 and has since continued to increase toward 1933 level. Drought, the dominant factor, has completely overshadowed effects of varying grazing intensity to date. Cactus and Sandberg bluegrass increased markedly during drought years. Calf crop and weaning weights have been consistently lower for cows on heavily grazed ranges. During 6 years, 1933-1939 (dry heifers used in 1937), the weaning calf crop averaged 75, 85, and 82½ percent, respectively, and aggregate weaning calf weights were 27,020, 33,796, and 32,840 pounds, respectively, for 20 cows on heavily, moderately, and lightly grazed lots. Total feed cost (range plus supplemental, six seasons) averaged 4.7, 3.3, and 3.6 cents, respectively, per pound of weaning weight. The overgrazed lots were 30 percent higher.

Data on sheep at five intensities started during 1936 drought not consistently significant because increased stocking has lagged behind improvement in range vegetation at all intensities since drought.

ACCOMPLISHMENTS DURING PAST YEAR: Partially compiled quadrat data for 1939 show grama nearly doubled its density over 1938. Some seedlings survived but increase due largely to tillering. Other important grasses trended upward though total density still somewhat below 1933 level. Sandberg bluegrass and cactus declined sharply but height growth most species above normal so animal months feed produced nearly up to 1933 level. Calf crop in 1939 the largest to date, 90, 90, and 95 percent and the average weaning weight 404, 449, and 422 pounds, respectively, the heaviest to date. One bull plan tried but unsatisfactory.

Utilization and distribution problem on sheep pastures not yet solved. Use of yearling wethers did not prove very helpful. Heavier stocking necessary. A campaign of poisoning kangaroo rats and eradication of noxious weeds carried on last summer. Continued study for better method of measuring utilization and for making comparisons between intensities.

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PLANS FOR 1940: Continue to study response of vegetation, cattle and sheep to weather, intensity of use, and other factors as basis for better management. Increase stocking on sheep ranges and adjust for better utilization and improve methods for measuring response of vegetation to treatments.

DATE OF COMPLETION: About 1947.

ASSIGNMENT: Leon C. Hurtt, E. J. Woolfolk, R. W. Collins, in cooperation with B.A.I. and Montana Agricultural Experiment Station at U. S. Range Livestock Experiment Station.

January 1940

RESEARCH METHODS IN RANGE PLANT ECOLOGY

FIELD DIVISION: Range Research

WORK PROJECT: Grazing Management

LINE PROJECT: Research Methods, Range Plant Ecology

PURPOSE OF WORK: Evaluate existing and devise better methods and procedures for measuring response of range vegetation to habitat factors and various treatments.

REVIEW OF PAST WORK: The "decimeter-frame estimate" method of measuring vegetal density shown from tests to be most satisfactory for use with series of paired major plots selected as being comparable but located in adjoining pastures. Work on charted quadrats continued with special effort made to improve analyses thereof. New device known as "plot transector" designed to measure extent of vegetation on plots along fixed transect lines. Preliminary trials showed the instrument to be promising as a tool in pasture comparisons. Study initiated to determine the resistance of grama and bluestem to three different summer grazing (clipping) treatments.

ACCOMPLISHMENTS DURING PAST YEAR: Progress made in improving utilization methods as outlined under Utilization Standards. Exhaustive test made to determine value of plot transector. Study planned and executed to determine effect of pasture division fences upon forage density and utilization. New system of plots located for continued study of resistance to clipping of grama and bluestem. Improvement made in locating and measuring plants in plant development study. Special attention given to development by field men of ability for keener and more analytical observational determination of vegetal and soil changes.

PLANS FOR 1940: Complete compilation and analysis of data collected in 1939 from above subprojects. Using results as foundation, extend search for more rapid and reliable methods of measuring vegetal resistance and response to various treatments which will be applicable to large areas of range land. Continue range forage utilization studies to develop method that is both reliable and rapid.

DATE OF COMPLETION: Indefinite.

ASSIGNMENT: R. W. Collins with assistance of E. J. Woolfolk.

January 1940

RANGE UTILIZATION STANDARDS

FIELD DIVISION: Range Research

WORK PROJECT: Grazing Management

LINE PROJECT: Management Short-grass Ranges - Utilization Standards

PURPOSE OF WORK: To develop practicable method and standards for judging when short-grass ranges are properly utilized.

REVIEW OF PAST WORK: Clipping of paired, protected, and grazed plots tested as possible means of measuring volume of forage utilized. Results not promising. Volume curves constructed for Agropyron smithii and Poa secunda. A new method consisting of random measurement of stubbles, estimates of percent of plants grazed, and use of volume curves to convert average stubble heights to percents of volume utilized started in fall of 1938. Four species considered as key indicators of use in summer cattle pastures and tested. Comparisons made of utilization on each of four species in each subtype, pasture, and grazing intensity. Similar utilization survey made in sheep pastures. Results not so satisfactory as for cattle pastures.

ACCOMPLISHMENTS DURING PAST YEAR: Point observation survey method extended to winter cattle pastures. Special study made of adequacy of sampling and effect of distance from water supply upon forage utilization. Agropyron smithii proved best indicator of differences in utilization. First attempt made to correlate differences in utilization on winter pastures with differences in early summer cattle gains within summer pastures. Second annual survey made of summer pastures (cattle and sheep) in fall of 1939. Sampling procedures improved to minimize effect of personal bias in observation and measurement and to give better distribution of sampling. Volume utilization curves constructed for grama and niggerwool. Studied possibility of using browsing of silver sage as an index of general forage utilization.

PLANS FOR 1940: Continuance of the program with special emphasis upon determining (1) most desirable key species for observation within each type of range land, (2) least expensive method of pasture sampling commensurate with reliability of results, (3) better means of correlating utilization values with cattle weights, (4) some additional work in construction and improvement of volume curves.

DATE OF COMPLETION: 1945.

ASSIGNMENT: E. J. Woolfolk,
R. W. Collins.

January 1940

MANAGEMENT SUMMER RANGES

FIELD DIVISION: Range Research

WORK PROJECT: Grazing Management

LINE PROJECT: Management Summer Ranges

PURPOSE OF WORK: Determine best management and utilization practices for summer cattle and sheep ranges, vegetation and economical production both considered.

REVIEW OF PAST WORK: Development of physical improvements mainly from CCC and ERA funds has been primary activity at Vigilante branch. Regular funds inadequate for research on full project basis but following studies initiated: phenological or plant development study shows two species 90 percent or more in boot stage in late May 1938, but that Agropyron spicatum lags about 3 weeks. A systematic utilization survey started in 1938 based on measuring stubble, estimating percent of ungrazed plants, and use of forage volume table developed by region. Results not yet conclusive but encouraging as basis for better method.

Replicated plots established in 1938 to determine cumulative effects of grazing (clipping) at three dates and varying height of stubble. Production greater first year on plots clipped three times in spring than when clipped once at the end of season. Above studies on cattle portion of range; nothing started on sheep portion of Vigilante range.

ACCOMPLISHMENTS DURING PAST YEAR: Clipping, plant development, and utilization studies continued but results not yet fully analyzed. In 1939 series of quadrats established to detect changes in density and composition on (a) range grazed throughout the season, (b) deferred, and (c) not grazed.

Pipe line about 7,500 feet long and water system completed at Vigilante, a class one road 5.8 miles long 90 percent completed, 1½ miles of truck trail and stock trail 1 mile long constructed, kitchen-messhall practically completed by CCC spike camp and ERA crew, also numerous plots fenced and forage nursery or work center developed.

PLANS FOR 1940: Continue improvement program as funds permit, continue development of utilization standards, plant development, and resistance to clipping studies. Establish plots to determine reason for contrast in sagebrush along Davis Creek drift fence and if CCC spike available contour and reseed severely eroded area at Lazyman Hill.

DATE OF COMPLETION: Indefinite.

ASSIGNMENT: T. E. Brierley and any assistance possible.

METHODS OF ARTIFICIAL REVEGETATION

FIELD DIVISION: Range Research

WORK PROJECT: Artificial Revegetation

LINE PROJECT: Methods

PURPOSE OF WORK: Develop low cost methods for the artificial revegetation of depleted or formerly plowed range lands.

REVIEW OF PAST WORK: In connection with adaptation tests with numerous species, low cost seeding methods have been stressed on approximately 1,735 acres including many dry-farmed areas successfully reseeded without expensive seedbed preparation. Successful stands of crested wheatgrass obtained on several unplowed but depleted Custer, Helena, Deerlodge, and Beaverhead National Forest areas by simply broadcasting and disking or by seeding in contour furrows on steep slopes. A heavy cutout disk very useful for soil preparation on uncultivated rocky or brush-covered slopes. Fall seeding of crested wheatgrass more successful than spring dates during drought years and early spring plantings have been more successful than late spring. Soil moisture during early seedling stage determines whether shallow covering, about $\frac{1}{2}$ inch, or deep cover, up to $1\frac{1}{2}$ inches, gives best stand of crested wheatgrass. About 4 to 5 pounds crested wheatgrass seed per acre appears adequate. A firm seedbed is important.

ACCOMPLISHMENTS DURING PAST YEAR: Testing of early and late spring and early and late fall planting dates continued in 1939 at Missoula, Vigilante, Miles City, and Thompson Falls with from 36 to 95 species at each place. Most legumes appeared best with spring planting dates at all locations. Fall dates were best for most grasses at Missoula, but spring seeding of grasses at Vigilante. approximately equal to fall seeding there under the more favorable conditions at this higher elevation, 6,200 feet. Results of recent tests at Miles City indeterminate but previous tests favored fall plantings there. Heavy cutout disk used to establish two demonstration tests on unplowed Beaverhead National Forest range, one on heavily trampled and one on steep sagebrush area. Results from previous years reseeding with furrow drill and double disk drill give the former the advantage in fall drilling and the double disk better in spring. At Miles City an experiment set up to further test field equipment of three kinds through cultural methods with four species and one mixture. A modified hand corn planter seems useful on inaccessible areas. Preliminary plans made for seeding burns from airplane when funds available. A summary of 6 years' results issued in mimeographed form.

PLANS FOR 1940: Prepare project analysis and work plans for revegetation studies and expand establishment methods work. Furnish detailed guidance for reseeding methods to forests and CCC camps as requested and give special assistance in revegetation of

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pastures at Bonita and Lincoln Ranger Stations. Adapt farm machinery to revegetation work on steep rocky and brushy lands. Summarize results of work to date for publication as Farmers' Bulletin.

DATE OF COMPLETION: Indefinite.

ASSIGNMENT: Leon C. Hurtt,
L. R. Short,
G. D. Merrick.

January 1940

SITE FACTORS IN ARTIFICIAL REVEGETATION

FIELD DIVISION: Range Research

WORK PROJECT: Artificial Revegetation

LINE PROJECT: Site Factors

PURPOSE OF WORK: Determine what edaphic, biotic, climatic, and other site factors favor or disfavor artificial revegetation.

REVIEW OF PAST WORK: Crested wheatgrass found tolerant to great range of site factors such as mineral content and certain other soil relations on reseeded areas from 2,300 to 8,600 feet elevation. Reduced soil temperatures due to partial shade an important factor in seedling survival, but competition of associated shade plants may overbalance this advantage. Tentative guide set up as to density or degree of competition from other species that precludes successful reseeding of crested wheatgrass. Effects of fertilizer tests not yet conclusive.

ACCOMPLISHMENTS DURING PAST YEAR: Results of competition on a considerable number of grass seedlings have been noted from weeded and unweeded plots. Survival of both spring and fall seedings was greatly reduced by weed competition, but fall seedings withstood competition generally better than spring planting. Density of competing vegetation may apparently be greater without precluding successful reseeding in western than in plains portion of state. Phosphate fertilizer failed to improve forage yield in certain tests made but nitrate appears to be limiting factor for this soil. Mountain brome, crested wheat, and tall oatgrass have survived 3 years at 8,600 feet but doubtful if any viable seed produced. Four species of *Agropyron* and two of *Elymus* produced seed at about 6,300 feet elevation that appears to be viable. Viability to be determined by tests.

PLANS FOR 1940: Determine factor (excess of lime) responsible for poor growth on Hansen area and develop certain phases of site factor study as resources permit.

DATE OF COMPLETION: Indefinite.

ASSIGNMENT: Leon C. Hurtt,
L. R. Short,
G. D. Merrick,
W. L. Norem.

January 1940

SPECIES AND MIXTURES FOR ATIFICIAL RANGE REVEGETATION

FIELD DIVISION: Range Research

WORK PROJECT: Artificial Revegetation

LINE PROJECT: Species

PURPOSE OF WORK: Test adaptability of certain species and mixtures for revegetation and test grazing value of promising ones.

REVIEW OF PAST WORK: Crested wheatgrass most successful on field and plot tests for more than 20 species tried on wide variety of conditions in plains and foothills area in 24 Montana counties during past 6 years. Numerous species tried appear to have little promise for range use, but sweet clover, smooth brome, Canada blue, and others do justify further study at lower elevations and tall oat, mountain brome, and others at higher elevations. Mixtures of crested wheatgrass, Ladak alfalfa, and Canada bluegrass beginning to show some promise at Miles City.

ACCOMPLISHMENTS DURING PAST YEAR: Considerable natural reseeding noted in reexamination of crested wheatgrass fields in competition with weeds and some apparent encroachment against downy brome competition in few cases. Adaptation tests for 36 species established in 1939 on formerly timbered area at Thompson Falls and additional species tried at Missoula, Vigilante, and Miles City, but seedling survival this year very poor at Miles City due to very dry spring. Five grasses, three new in our program, have outstanding promise from recent tests. A good stand of crested wheatgrass produced this year at Vigilante from seed grown at 6,200 feet elevation. Seed from high altitude collected for germination tests and germination tests made with certain seeds after acid treatments.

Spring cattle gains much higher per acre from crested wheatgrass than from native range, but gains per animal higher on latter in preliminary test last year. Species as well as methods are being studied in replicated field tests established last October at Miles City.

PLANS FOR 1940: Establish adaptation tests of new species and mixtures in nurseries and carry tests of promising ones to field conditions. Continue grazing value tests of crested wheatgrass for cattle. Prepare summary of results to date for publication in Farmers' Bulletin.

DATE OF COMPLETION: Indefinite.

ASSIGNMENT: Leon C. Hurtt,
G. D. Merrick,
L. R. Short.

COOPERATIVE WESTERN RANGE SURVEY

FIELD DIVISION: Range Research

WORK PROJECT: Grazing Management

LINE PROJECT: Western Range Survey (Region E)

PURPOSE OF WORK: The Cooperative Western Range Survey project was inaugurated in April 1937 looking towards the ultimate assembly of a detailed inventory of the range resources throughout the 17 western states. Region E includes all of Montana, 10 counties in northern Idaho, and 4 counties in northeastern Washington. The project is designed to prepare maps and tabulations of all grazing land covered by range surveys for the use of ranchmen and for land-use planning and administrative agencies. From these maps and tabulations, together with the written descriptions, the location, extent, kinds, density, and composition of the plant cover, the grazing capacity of range areas may be determined. With this information available the management practices essential for the maintenance, improvement, and proper use of the range may be worked out.

REVIEW OF PAST WORK: Completed the drafting of grazing survey maps, and tabulated the grazing capacity by sections on approximately 7½ million acres of range land situated in 10 eastern Montana counties. Analyzed the data and prepared reports on the 10 counties. Prepared a more complete and detailed report on Petroleum County. The project was discontinued officially on June 30, 1938, due to lack of funds. Six man months' time contributed by Region One and station personnel since July 1, 1938. Work accomplished includes answering numerous letters requesting information or maps and reviewing of revised Petroleum County reports.

ACCOMPLISHMENTS DURING PAST YEAR: Continued to fill requests for information and maps already compiled.

PLANS FOR 1940: Continue to fill requests for information and maps already compiled.

DATE OF COMPLETION: Indefinite. No funds for project now available.

ASSIGNMENT: L. C. Hurtt,
G. D. Merrick.

FLOOD CONTROL SURVEYS

FIELD DIVISION: Flood Control Surveys

WORK PROJECT: Flood Control Surveys

LINE PROJECT: Preliminary examinations to determine existence of flood problems.

PURPOSE OF WORK: To make preliminary examinations of watersheds to determine existence of flood problems, as specified by the Flood Control Act of 1936, as amended.

REVIEW OF PAST WORK: Project initiated fall 1937, appointment of flood control committee, joint public hearings on Spokane River, Yellowstone River, Clarks Fork River, Kootenai River, and Colville River drainages. Preliminary examination report for the Spokane River drainage made in cooperation with the Bureau of Agricultural Economics and the Soil Conservation Service and transmitted to Washington.

ACCOMPLISHMENTS DURING PAST YEAR: Due to a reorganization of the administration of and procedure for flood control surveys within the Department of Agriculture no personnel was assigned to flood control surveys at this station. The station participated in a second joint hearing on the Colville River drainage, a meeting on the St. Regis River drainage, and a number of meetings with the field coordinating committee. Some collection of flood damage and other data was made on the Clarks Fork, Colville, and Kootenai River drainages.

PLANS FOR 1940: Complete preliminary examination reports on the St. Regis River and Flathead River drainages. Prepare and submit work outline for the Spokane River survey. If funds available after June 30, 1940, complete preliminary examination reports for Kootenai River and Colville River drainages.

DATE OF COMPLETION: Continuing. Dependent upon allotment of flood control funds.

ASSIGNMENT: Arthur W. Greeley until June 30, 1940. Melvin Bradner, in cooperation with representatives of Bureau of Agricultural Economics, Soil Conservation Service, and War Department Engineers.

PUBLICATIONS

I. PUBLISHED DURING 1939

A. Departmental Bulletins

None.

B. Outside Publications

The farm woodlot, a source of permanent income if handled wisely. I. V. Anderson. Montana State University Bulletin no. 367. June 1939.

Controlled burning in the western white pine type. Kenneth P. Davis and Karl A. Klehm. Journal of Forestry 37(5):395-407. May 1939.

Forest pyrology [illegible]. The Scientific Monthly, vol. 49, pp. 21-30. July 1939.

Short-term forest workers. H. T. Gisborne. Fire Control Notes, 3(3):27-30. July 1939.

Hornby's principles of fire control planning. H. T. Gisborne. Journal of Forestry 37(4):292-296. April 1939.

Overgrazing increases production costs. Leon C. Hurtt. The Cattleman, vol. 36, no. 5. October 1939. The same article also carried in the American Cattle Producer, vol. 21, no. 7. December 1939.

Cheatgrass not all evil. Leon C. Hurtt. The American Hereford Journal. October 15, 1939.

Development of branches and knots in western white pine. E. F. Rapraeger. Journal of Forestry 37(3):239-245. March 1939.

Matches from Idaho's white pine. E. F. Rapraeger. American Forests, 45(3):112-114. March 1939.

Range of log prices in the northern rocky mountain region in 1938. E. F. Rapraeger. The Timberman 40(7):28. May 1939.

Survival in forest plantations in the northern rocky mountain region. C. S. Schopmeyer. Journal of Forestry 38(1):16-24. January 1940.

APPENDIX

PUBLICATIONS

I. PUBLISHED DURING 1939

A. Departmental Bulletins

None.

B. Outside Publications

Prod

The farm woodlot, a source of permanent income if handled wisely. I. V. Anderson. Montana State University Bulletin no. 367. June 1939.

Silv

Controlled burning in the western white pine type. Kenneth P. Davis and Karl A. Klehm. Journal of Forestry 37(5):399-407. May 1939.

Fire

Forest pyrology. H. T. Gisborne. The Scientific Monthly, vol. 49, pp. 21-30. July 1939.

"

Short-term forest workers. H. T. Gisborne. Fire Control Notes, 3(3):27-30. July 1939.

"

Hornby's principles of fire control planning. H. T. Gisborne. Journal of Forestry 37(4):292-296. April 1939.

Range

Overgrazing increases production costs. Leon C. Hurtt. The Cattleman, vol. 36, no. 5. October 1939. The same article also carried in the American Cattle Producer, vol. 21, no. 7. December 1939.

"

Cheatgrass not all evil. Leon C. Hurtt. The American Hereford Journal. October 15, 1939.

Prod

Development of branches and knots in western white pine. E. F. Rapraeger. Journal of Forestry 37(3):239-245. March 1939.

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Matches from Idaho's white pine. E. F. Rapraeger. American Forests, 45(3):112-114. March 1939.

"

Range of log prices in the northern rocky mountain region in 1938. E. F. Rapraeger. The Timberman 40(7):28. May 1939.

Silv

Survival in forest plantations in the northern rocky mountain region. C. S. Schopmeyer. Journal of Forestry 38(1):16-24. January 1940.

C. Multilithed and Mimeographed Progress Reports

Grading of logs and trees as a means of measuring quality. I. V. Anderson. April 1939. Mimeographed. Prod

The Christmas tree industry. I. V. Anderson and E. F. Rapraeger. January 1939. Processed. "

A preliminary study of root diseases in western white pine. John Ehrlich, University of Idaho. Station paper no. 1. October 1939. Mimeographed. (Report on cooperative study.) Silv

Character of the 1939 fire season in region one. H. T. Gisborne. Applied Forestry Notes no. 93. November 1939. Mimeographed. Fire

Overgrazing increases production costs by reducing number and weight of range calves. Leon C. Hurtt. Applied Forestry Notes no. 92. September 1939. Mimeographed. Range

Downy brome (cheatgrass) range for horses. Leon C. Hurtt. Applied Forestry Notes no. 89. January 1939. Mimeographed. "

Advice on artificial reseeding for CCC use region one. Leon C. Hurtt. (Distributed to forests and others.) Mimeographed. "

Possibilities of partial cutting in young western white pine. E. F. Rapraeger. Station paper no. 2. January 1940. Mimeographed. Prod

The cubic foot as a national log-scaling standard. E. F. Rapraeger. January 1940. Mimeographed. "

Christmas tree production in western Montana, 1939. E. F. Rapraeger. Research note no. 2. January 1940. Mimeographed. "

Forest industries of the Inland Empire: the Christmas tree industry of western Montana. E. F. Rapraeger. October 1939. Multilithed. "

Successful forestation by direct seeding using poisons for rodent control. C. S. Schopmeyer. Research note no. 1. January 1940. Mimeographed. Silv

Direct seeding in the western white pine type. C. S. Schopmeyer. Applied Forestry Notes no. 90. May 1939. Mimeographed. "

Consumption of timber products in the northern rocky mountain region. C. N. Whitney and S. Blair Hutchison. Forest survey release no. 17. January 1940. Multilithed. Products

Survey

Western red cedar pole resources in North Idaho and northeastern Washington. Forest Survey Staff. A forest survey progress report. Forest survey release no. 16. March 1939. Multilithed.

Prod

Production of lumber, lath, and shingles in Idaho and Montana, 1938. C. N. Whitney. Applied Forestry Notes no. 91. August 1939. Mimeographed.

Instructions for preservative treatment of telephone poles, stubs, and fence posts - region one. C. N. Whitney, prepared in collaboration with the regional division of engineering. January 20, 1939. Mimeographed. "

Stumpage prices since 1912. Division of Forest Products. Revised April 1939 to include 1938 figures. Mimeographed. "

Lumber selling values since 1913. Division of Forest Products. Revised April 1939 to include 1938 figures. Multilithed.

Lumber production for the northern rocky mountain region. Division of Forest Products. Revised September 1939 to include 1938 figures. Multilithed. "

No. Summary of Bus. Conditions in the Lbr Industry - issued monthly, Jan-Dec. 1939

III. ARTICLES AND OTHER MANUSCRIPTS PROPOSED FOR OUTSIDE PUBLICATION DURING C.Y. 1940

II. ESTIMATE OF DEPARTMENTAL PRINTING NEEDS

A. Formal Manuscripts to be Submitted for Departmental Publication Prior to June 30, 1940

Influence of altitude and aspect on daily variations in factors of forest fire danger. O. L. Hayes. Thoroughly edited by Washington Office. Manuscript sent to Monthly Weather Review but declined due to reduced funds and accumulated material.

Drought an important but underrated factor in management of northern great plains ranges. Leon C. Hurtt. U. S. Dept. Agric. technical bulletin, 35-40 pages. Illus.

B. Formal Manuscripts to be Submitted for Departmental Publication During F.Y. 1941

Forest resources of northern Idaho. S. B. Hutchison and R. K. Winters. U. S. Dept. Agric. miscellaneous publication, 40-50 pages.

III. ARTICLES AND OTHER MANUSCRIPTS PROPOSED FOR OUTSIDE PUBLICATION DURING C.Y. 1940

Stand improvement practice in region one. Kenneth P. Davis. For Journal of Forestry.

In defense of controlled burning. Kenneth P. Davis. Submitted to Journal of Forestry.

Economic management of western white pine forests. Kenneth P. Davis. For Northwest Science.

What constitutes a critical fire season. H. T. Gisborne. For Journal of Forestry.

Fire control objectives. H. T. Gisborne. For Journal of Forestry.

Forest resources of northern Idaho. S. B. Hutchison and R. K. Winters. A brief trade journal article taken from departmental publication of same name.

The market factor in the forest problem of the Inland Empire. S. B. Hutchison. Trade journal article.

Effect of screens on surface soil temperatures. C. S. Schopmeyer. For Journal of Forestry.

Procedure for artificial revegetation of Montana ranges. L. R. Short and G. D. Merrick. For Farmers' Bulletin, 12-18 pages.

A visual method for estimating light intensity beneath forest canopies. C. A. Wellner. For Ecology.

Relationship between number of trees and degree of stocking in natural reproduction in the western white pine type. C. A. Wellner. For Journal of Forestry.

Treating fenceposts on the farm. C. N. Whitney. For the Montana Farmer.

Range recovery after the 1934-37 drought. E. J. Woolfolk and W. Luther Norem. For Ecology or Journal of Forestry, 9-12 pages.

Some effects of burning and grubbing silver sage on short-grass ranges. E. J. Woolfolk and W. Luther Norem. For Ecology or Journal American Society of Agronomy.

DIRECTORY OF PERSONNEL

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

February 1, 1940

OVERHEAD ADMINISTRATION

Melvin I. Bradner	Director
Mary J. Pershina	Junior Administrative Assistant
Dagmar Nelson	Senior Stenographer
Helen B. Davis	Assistant Clerk-Stenographer

FIELD STATIONS

Deception Creek Experimental Forest	Elton E. Bentley
Priest River Experimental Forest	Donald G. McKeever
Miles City Experimental Range	E. Joseph Woolfolk
Vigilante Experimental Range	Tom E. Brierley

DIVISION OF SILVICULTURE

Silv.		Mensuration		Regeneration
75%	Kenneth P. Davis	20%	Silviculturist, In Charge	5%
95%	Charles A. Wellner	5%	Assistant Silviculturist	
	Clifford S. Schopmeyer		Junior Plant Physiologist	100%
	William B. Petersen		Assistant Field Assistant	100%
100%	Elton E. Bentley		Head Forest Guard	

DIVISION OF FOREST PROTECTION

Harry T. Gisborne	Senior Silviculturist, In Charge
G. Lloyd Hayes	Assistant Forester
Donald G. McKeever	Junior Forester
Vern L. Cline	Minor Assistant to Technician
Bert L. Naiman	Minor Assistant to Technician
Chalmer K. Lyman	Junior Forester
George F. Weyermann	Assistant to Technician

DIVISION OF RANGE RESEARCH

Graz.Man.		Art. Reseed.	
80%	Leon C. Hurtt	20%	Senior Range Examiner, In Charge
	Gordon D. Merrick	100%	Associate Forest Ecologist
	Laurence R. Short	100%	Assistant Range Examiner
100%	E. Joseph Woolfolk		Assistant Superintendent
50%	W. Luther Norem	50%	Junior Plant Physiologist
100%	Tom E. Brierley		Junior Range Examiner
100%	Robert W. Collins		Junior Range Examiner
100%	Clark E. Holscher		Assistant Technician
100%	Anthony B. Evanko		Under Assistant to Technician
75%	Henrietta A. Pissot	25%	Junior Clerk-Stenographer

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DIVISION OF FOREST PRODUCTS

Tim.Har.		Prod.Stat.	Wood Pres.	
90%	Elmer F. Rapraeger	10%		Associate Forester, In Charge
	Chester N. Whitney	70%	30%	Associate Forester
20%	Marie E. Bouchard	80%		Assistant Clerk

DIVISION OF FOREST SURVEY

Robert K. Winters	Senior Forester, In Charge
Paul D. Kemp	Associate Forest Economist
S. Blair Hutchison	Assistant Forest Economist
William L. Royer	Assistant Forester
Clarence W. Brown	Assistant Technician
Howard B. Hawk	Assistant Technician
Orlo B. Johnson	Assistant Technician
Melvin E. Metcalf	Under Assistant to Technician
Eric G. Rutquist	Under Assistant to Technician
Robert L. Conn	Minor Assistant to Technician
Paul H. Isaac	Minor Assistant to Technician
Bruce W. Newton	Minor Assistant to Technician
Jesse M. Honeywell	Field Assistant
Henry J. Pissot	Under Field Assistant
John B. LaCasse	Assistant Statistical Draftsman
Frances Hughes	Junior Clerk-Stenographer

FLOOD CONTROL SURVEY

Arthur W. Greeley	Assistant Forester

DIRECT AND INDIRECT COSTS BY FINANCIAL PROJECTS

F.Y. 1940

Financial Project	Indirect Project Costs (Overhead)	Direct Project Costs	Total Costs
Forest Management	$ 3,743	$ 23,007	$ 26,750
Range Research	4,816	28,284	33,100
Forest Products	800	11,300	12,100
Forest Survey	5,141	29,859	35,000
Total	$ 14,500	$ 92,450	$ 106,950
Flood Control Surveys	500	3,500	4,000
Grand Total	$ 15,000	$ 95,950	$ 110,950

DISTRIBUTION OF DIRECT COSTS BY MAIN PROJECTS

F.Y. 1940

Financial and Work Project	Cars, maintenance, & new	Scientific equipment, etc.	Travel expenses: other than cars	Salaries: Regular	Salaries: Temporary	Total
FOREST MANAGEMENT						
Silviculture	$ 25	$ 300	$ 470	$ 6,320	$	$ 7,115
Mensuration	25	170	80	890		1,165
Regeneration	25	100	250	2,810		3,185
Forest fire protection	50	987	800	9,705		11,542
Total	125	1,557	1,600	19,725		23,007
RANGE RESEARCH						
Grazing Management	150	467	1,000	17,502		19,119
Artificial revegetation	550	400	500	7,715		9,165
Total	700	867	1,500	25,217		28,284
FOREST PRODUCTS						
Timber harvesting and conversion	50	150	600	4,948		5,748
Wood preservation			50	990		1,040
Forest products statistics		500	200	3,812		4,512
Total	50	650	850	9,750		11,300
FOREST SURVEY						
Survey of forest resources, etc.	360	740	3,188	23,058	2,513	29,859
FLOOD CONTROL SURVEYS	200	300	1,000	2,000		3,500

INCREASES NEEDED FOR NEW RESEARCH

Although it would be preferable to concentrate for the present on building up and adequately financing the major lines of work already established at this station, there are a number of new projects and new fields in which work, even if on a small scale, should be initiated. We, ourselves, are in need of and are being called upon for information on forest and range influences, range resources and conditions, and on the economics of the situation in the lumber and livestock industries.

There are tabulated below the appropriation increases necessary to build up the old established lines of work to a point where the station can redeem its responsibility as the foremost research agency within the region and those needed to initiate new projects and lines of work.

OLD ESTABLISHED LINES OF WORK

Field Division, Work Project, and Line Project	Amount Increase Needed	Priority
FOREST MANAGEMENT RESEARCH		
Forest Fire Research		
Fire Control Planning	$ 10,000	1
Silviculture		
Management White Pine	$ 5,000	1
Mensuration	8,000	1
Management Other Types	15,000	2
Regeneration	7,000	3
RANGE RESEARCH		
Grazing Management		
Summer Ranges	$ 15,000	1
Spring-Fall Ranges	10,000	2
Artificial Revegetation	$ 10,000	2
FOREST SURVEY	$ 50,000	1
FOREST PRODUCTS		
Timber Harvesting & Conversion	$ 5,000	1
Regional Little-Use Species Problems	$ 5,000	1
IMPROVEMENT CONSTRUCTION	$ 142,000	2
IMPROVEMENT MAINTENANCE	$ 6,000	1

Statements and justification sheets for the increases for the new projects and lines of work follow.

NEW PROJECTS AND LINES OF WORK

Field Division, Work Project, and Line Project	Amount Increase Needed	Priority
FOREST MANAGEMENT RESEARCH		
Forest Fire Protection		
Behavior - Rate of Spread	$ 15,000	1
RANGE RESEARCH		
Grazing Management		
Western Range Survey	$ 25,000	1
FOREST ECONOMICS		
Private Forestry		
Financial Aspects in the White Pine Type of Northern Idaho	$ 15,000	1
Range Economics		
Range Economics	$ 10,000	2
FOREST AND RANGE INFLUENCES		
Influence of Natural Vegetation on Streamflow		
Relation of Forest Cover to Streamflow	$ 15,000	1
Relation of Woodland and Grassland Cover to Streamflow	$ 15,000	2

Statements and justification sheets for the increases for the new projects and lines of work follow.

JUSTIFICATION FOR APPROPRIATION INCREASE

FIELD DIVISON: Forest Management

WORK PROJECT: Forest Fire Protection

LINE PROJECT: Fire Behavior - Rate of Spread

An annual allotment of at least $15,000 extended over a period of 5 years is urgently needed to determine accurately the rate of spread of fire through each of the many different timber and fuel types of the Northern Rocky Mountain region under each of the several broad classes of weather that may and do prevail annually.

To conduct such research properly, at least two high caliber men and several assistants will be needed. The leaders must be thoroughly experienced in forest fire behavior in order to minimize the personal danger and must in addition be well trained in physics and meteorology, the two sciences basic to a proper understanding and measurement of fire behavior.

JUSTIFICIATION FOR APPROPRIATION INCREASE

Fire Behavior - Rate of Spread

The fire problem is the basic and most important forest problem throughout the Northern Rocky Mountain region. Without adequate fire control at reasonable cost the more than 30 million acres of forest land, bearing some 92 billion board feet of merchantable timber, cannot be made to contribute its fullest possible social-economic benefits to this region and to the rest of the country. No other part of the United States is subjected to as many forest fires caused by lightning over a period of years, and few other parts bear a forest growth exposed to a climate more conducive to rapidly spreading fires of equal difficulty of control.

Research by the Northern Rocky Mountain Forest and Range Experiment Station devoted to this problem has already improved the efficiency of fire control very materially. The fire danger meter for measuring forest fire danger and the methods of fire control planning to insure the proper distribution of adequate man-power and facilities have done this. Both of these research results also have been copied, imitated, modified, and applied throughout other forest fire regions of the United States, and by many other agencies including the Park Service, Indian Service, State, and private foresters. The research has therefore been of far more than local value.

One new and exceedingly difficult, even dangerous, research project is now needed by the thorough investigation of one phase of the forest fire problem which had to be handled empirically, or by judgment alone, in the early work. This is the accurate determination of rates of spread of fire through each of the many different timber and fuel

types of this region under each of the several broad classes of weather that may and do prevail annually.

Accurate determination of the probable rate of spread of each new fire obviously is essential to the decision as to how many men and how much equipment shall be sent to that fire. Too many men and too much equipment result in unnecessary expense as well as danger to other parts of the area by reducing the force and equipment in reserve. Sending too few men and inadequate equipment has, too often in the past, resulted in great losses of timber destroyed and extremely large costs for final suppression of the fire that thereby escaped initial control.

By systematic measurements on actual fires and by the use of experimental or test fires the needed information can be obtained in the course of a few seasons. Without such research dependence must be placed upon mass analysis of ordinary fire reports, incomplete in many respects, especially the weather conditions at the fire, inherently inaccurate in some respects due to the labor-type of men used as smoke-chasers and often the only men at the fire in its early stages, and inadequate in that the worst fuel types producing the smallest number of fires yet by far the largest proportion of area burned will be represented by so few reports that a long period of years must elapse before even moderately dependable conclusions can be drawn.

An annual allotment of at least $15,000 will be required for this work for a period of about 5 years.

FIELD DIVISION: Range Research

WORK PROJECT: Grazing Management

LINE PROJECT: Western Range Survey

An allotment of $25,000 annually, extending over a period of 6 years, is urgently needed to continue the Cooperative Western Range Survey project discontinued June 30, 1938.

A detailed inventory of the location, extent, values, and present condition of the grazing resources is necessary to determine those management and betterment practices which are essential for the proper development, conservation, and use of the range lands for the social and economic welfare of the region.

Range surveys have now covered 42 million acres, or around 65 percent of all range lands in the region. About 32 million acres of these range surveys were done during the past 3 years mainly under the AAA program or by the Farm Security Administration and Soil Conservation Service. Range surveys of some 10 million acres of national forest land have also been made to date. The Cooperative Western Range Survey project, while active, completed the drafting of grazing surveys, maps, and tabulated the grazing capacity by sections on approximately 7½ million acres of range land situated in ten eastern counties. Thus, compilation work has only been completed on 23 percent of the 32 million acres of private and public land on which range survey data are already available. The work of compiling, placing on maps, and analyzing the data on the national forest range surveys is being done currently. There still remains some 23 million acres of range land on which field surveys have not yet been made.

In order to carry out this work efficiently, a high caliber project leader, two first-class assistants, and a number of statistical clerks with range survey experience, and draftsmen are needed. The project leader should be well trained in the technique and methods used in range surveys and should have a wide knowledge of range conditions within the region. The two assistants should be junior range examiners with some experience on range surveys.

JUSTIFICATION FOR APPROPRIATION INCREASE

Western Range Survey

Livestock production is one of the major industries upon which much of the development and prosperity of the Northern Rocky Mountain region has been based. The range lands in this region comprise approximately 65 million acres, or 60 percent of the total land area in all forms of federal, state, county, and private ownership. The range resources, in Montana particularly, occupy a key position in any general adjustment and conservation program for the West.

A detailed inventory of the location, extent, value, and present condition of the grazing resources is necessary to determine those management and betterment practices which are essential for the proper development, conservation, and use of the range lands for the social and economic welfare of the region. The basic data made available by such a range inventory can also be used as a guide for the restocking of the drought area and as a basis for equalizing taxation of range lands.

Range surveys have now covered approximately 42 million acres, or 65 percent, of all range lands in this region. Around 32 million acres of these range surveys have been conducted during the past 3 years mainly under the AAA program or by the Farm Security Administration and Soil Conservation Service. The bulk of these recent surveys have been done on privately owned range land. Range surveys of some 10 million acres of national forest land have also been made to date.

The Cooperative Western Range Survey project was inaugurated in April 1937 looking towards the ultimate assembly of a detailed inventory of the range resources throughout the 17 western states. The project was designed to prepare maps and tabulations of all grazing land covered by range surveys for the use of ranchers and for land-use planning and by administrative agencies. From these maps and tabulations, together with the written descriptions, the location, extent, kinds, density, and composition of the plant cover, the grazing capacity of range areas was to be worked out. The project at this station was organized to cover the Northern Rocky Mountain region (WRS Region E).

The Cooperative Western Range Survey project at this station, which was initiated in April 1937 and discontinued because of lack of funds on June 30, 1938, completed the drafting of grazing survey maps and tabulated the grazing capacity by sections on approximately 7½ million acres of range land situated in 10 eastern Montana counties. The data were analyzed and reports prepared for the 10 counties pointing up the important range problems in each county with recommendations for improving and conserving the range resources.

When the Cooperative Western Range Survey project was discontinued on June 30, 1938, there was an estimated 18½ million acres (15½ million in Montana) of unassembled AAA range survey data which were ready to be compiled, tabulated, and the data placed on maps. During the 1938 field season range surveys by the AAA and other agencies covered an additional 7 million acres in Montana. This

coverage is in addition to the 10 million acres of national forest range surveys which have been made, compiled, and mapped to date.

Judging by the present use of WRS material and the numerous requests from many individuals, organizations, and agencies for this information, it is evident that the uniform maps and tabulations, together with the written reports, are being used extensively by livestock operators, state grazing associations, and land-use planning agencies in the administration of individual operating units, grazing association, and public-owned range lands. For this reason, the continuation of the work of the Western Range Survey is bound to be an important factor in securing the proper application of a set of land management practices that will reasonably insure the restoration and future maintenance of the soil and range resources at their most productive level.

An allotment of $25,000 annually for a 6-year period is urgently needed to continue and complete the Western Range Survey in the Northern Rocky Mountain region.

JUSTIFICATION FOR APPROPRIATION INCREASE

FIELD DIVISION: Forest Economics

WORK PROJECT: Private Forestry

LINE PROJECT: Financial Aspects in the White Pine Type of Northern Idaho

An allotment of $15,000 is needed to initiate a new project for the purpose of studying the financial aspects of forestry in the white pine type of northern Idaho. The purpose of such a study is to determine and demonstrate profitable methods of management of the white pine forests of northern Idaho for the continuous production of commercially valuable forest products and for the highest economic use of the land. The orderly and profitable management of such timber lands requires a comprehensive study to determine (1) the extent of and the specific causes for forest land delinquency; (2) the financial returns to be expected under private, state, and federal ownership; and (3) the feasibility of sustained yield management for the type.

This allotment will be used to obtain the services of a forest economist in the P-4 grade, who will take charge of the project. An assistant in the P-1 grade, one full-time statistical clerk, and from 12 to 18 man-months of temporary help will also be needed. Traveling expenses, station overhead, and office supplies will use the balance of the allotment. During F.Y. 1941 funds and personnel will be used most efficiently in collecting information on the tax delinquency phase of the problem and compiling and analyzing the data.

The allotment of $15,000 to the Northern Rocky Mountain Forest and Range Experiment Station will be required to properly finance the initiation of this project.

JUSTIFICATION FOR APPROPRIATION INCREASE

Financial Aspects in the White Pine Type of Northern Idaho

Lumbering in the white pine forests of northern Idaho is the major industry and the only support for many communities. The high cost of carrying land, due to heavy fire control costs, timber taxes, costly silvicultural measures necessary to perpetuate the white pine type, and the threat of blister rust damage, seriously challenges the feasibility of a stabilized and permanent forest industry under private ownership. There has been a very rapid and disturbing break-down in private land ownership. Nearly 1/4 million acres of cutover land have passed to the counties through tax delinquency and more than 240,000 acres have been donated to the Federal Government. Cutting in the majority of the white pine stands of northern Idaho has progressed so far that sustained yield management on anything like the present cut is already impossible. As a result, many of the forest communities have become decadent, and others are rapidly tending toward that end. The future of the industry is in the balance. All of this in spite of the fact that white pine produces the most valuable lumber of any of our western species.

The orderly management of timberlands in the white pine type requires a comprehensive study to determine (1) the extent of and the specific cause for forest land delinquency; (2) the financial returns to be expected under private, state, or federal ownership; and (3) the feasibility of sustained yield management for the type.

The allotment of $15,000 to the Northern Rocky Mountain Forest and Range Experiment Station will be required to properly finance the initiation of this project.

JUSTIFICATION FOR APPROPRIATION INCREASES

FIELD DIVISION: Forest Economics

WORK PROJECT: Range Economics

LINE PROJECT: Range Economics

An allotment of $10,000 is needed to initiate a new project for the purpose of studying the major readjustments away from dry farming towards more reliance on range livestock production. There is a great need for research data to guide these adjustments so that costly mistakes in future land use may be avoided.

To initiate such research, a project leader of high caliber, field assistance, and clerical help are needed. The leader must be trained in agricultural economics, preferably one who has given special attention to the economics of both forest and range lands and their relationships with other agricultural problems.

FIELD DIVISION:

WORK PROJECT:

LIFE PROJECT:

JUSTIFICATION FOR APPROPRIATION INCREASES

Forest Economics - Range Economics

For a regional program of research in the field of range economics an initial allotment of $10,000 is needed for the fiscal year 1941.

Major readjustments away from dry farming toward more reliance on range livestock is in progress generally on an area aggregating about 75 million acres in this region. There is great need for research data to guide these adjustments so that costly mistakes in land use may be avoided. The size of a ranch home unit which will provide a satisfactory standard of living, the hazards of submarginal land ownership, better marketing practices for range livestock, and the best balance in use of range with cropland and feeds, must be carefully evaluated to guide a sound program of developments for succeeding generations.

FIELD DIVISION: Forest and Range Influences

WORK PROJECT: Influence of Natural Revegetation on Streamflow

LINE PROJECT: Relation of Forest Cover to Streamflow in the Western White Pine Type

An allotment of $15,000 is needed to start this project. The purpose of the project is to determine the comparative influence of forest, brush, and other vegetative cover and bare land, under varying conditions of topography, soil, precipitation, and other factors, in:

(a) Retarding run-off
(b) Delivering maximum amounts of usable water
(c) Preventing destructive floods
(d) Controlling erosion and consequent downstream silting
(e) Maintaining soil productivity.

The work at the start will be to select, survey, and map an experimental area embracing comparable and adjoining watersheds, and to plan the location and installation of dams, weirs, lysimeters, meteorological, and other necessary equipment, and also to plan the building of the required physical plant.

The requested allotment of $15,000 will provide for the following: One project leader in the P-5 grade, one assistant in the P-2 grade, one soil expert in the P-3 grade, and three field assistants.

To determine exactly the influence of different types of cover such as forest, brush, and grass in retarding run-off in this region, and to determine the deleterious effect on loss of soil fertility caused by this erosion and run-off, there is needed the proper experimental setup of dams, weirs, lysimeters, and other measuring devices placed in adjoining drainages of different cover conditions.

JUSTIFICATION FOR APPROPRIATION INCREASE

Relation of Forest Cover to Streamflow in the Western White Pine Type

Northern Idaho and western Montana embrace an important part of the headwaters of the Columbia River. Destructive fires and logging have removed much of the natural forest cover, leaving barren and brush-covered slopes. Under such conditions the heavy rains that frequently come in winter find no green crown canopy to break their force; no duff cover to absorb the excessive downpour. The effect is rapid run-off, resulting locally in soil erosion and swollen conditions of the streams. Major floods, like that of December 1933, when the monthly downpour amounted to 12 inches, do great damage to highways and railroads, and destroy bridges and private property. The more important damage, however, comes from the more frequent minor floods, the combined effect of many of which, in the numerous headwater streams of the Columbia, is the vast downstream losses in silting of channels and sedimentation of reservoirs, the largest of which in time will be the Grand Coulee and Bonneville projects.

FIELD DIVISION: Forest and Range Influences

WORK PROJECT: Influence of Natural Vegetation on Streamflow

LINE PROJECT: Relation of Woodland and Grassland Cover to Streamflow

An allotment of $15,000 is requested to start this project. The purpose of this project is to determine the influence of grass and other vegetative cover, in conjunction with proper range use, in conserving water supplies for irrigation and other purposes and in controlling erosion in eastern Montana.

The work at the start will be to select, survey, and map a suitable experimental area or areas, and to plan the location and installation of equipment for measuring soil erosion, water run-off, and meteorological factors, and also to lay out and plan the fencing of areas for different types of range utilization practices.

The requested allotment of $15,000 will provide for the following: One project leader in P-5 grade, one assistant in P-2 grade, one soil expert in P-3 grade, and three field assistants.

JUSTIFICATION FOR APPROPRIATION INCREASE

Relation of Woodland and Grassland Cover to Streamflow

The conservation of water supplies for irrigation use and the prevention of run-off and soil erosion that result in very serious sedimentation of reservoirs are of vital importance in the portion of Montana east of the Continental Divide. Among the many storage reservoirs of eastern Montana that suffer from sedimentation and consequent limitation of storage capacity, the largest is that of the Fort Peck project.

The problem in this territory is further complicated by the grazing of livestock which, under the slightest misuse, greatly accelerates run-off and erosion.

Besides existing irrigation projects, heavy expenditures are now being made by various agencies for numerous small irrigation projects, stock water storage, and other water-conserving undertakings in the plains and foothill territory. Studies have not yet been made in this region to serve as a basis for safeguards to these water projects that represent many million dollars invested.

Important questions that require research are:

(a) What is the comparative effectiveness of tree, brush, and grass cover in controlling run-off in the more mountainous headwater sections of eastern Montana?

(b) What forage species and what density of cover will provide the best watershed protection in the foothill section?

(c) How can the required density and composition be built up and maintained?

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— The general statement is exceptionally good RKm

(d) What degree of range use is allowable from an erosion and run-off standpoint?

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(e) How can the maximum amount of usable water be delivered where needed?

Under the wide range of conditions in the territory the problem is two-fold and involves study in (1) the mixed forest and glade type of cover at the headwaters of streams farming the important Missouri River drainage system, and (2) the grass and shrubby cover type of the plains and foothills where, under conditions of semiarid climate and over-utilization of forage, the situation with respect to loss of soil fertility by sheet and gully erosion, and the rapid loss of water through run-off has become particularly acute and constitutes one of the major regional problems.

Northern
Rocky Mountain
Forest & Range
Experiment Station
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